Regional Operational Plan SF.2A.2018.21

Operational Plan: Ninilchik River Chinook Salmon Stock Assessment and Supplementation, 2018

by

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and

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October 2018

Alaska Department of Fish and Game Divisions of Sport Fish and Commercial Fisheries

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat or long
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	log_2, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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SIGNATURE/TITLE PAGE

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Approval

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ABSTRACT

The Ninilchik River Chinook salmon escapement will be monitored at a broodstock weir located approximately 7.7 river kilometers (RKM) upstream of the mouth of the river from mid-May through mid-August. The run will be monitored with respect to the sustainable escapement goal of 750–1,300 wild Chinook salmon. Instream video monitoring will be used before and after broodstock collection so that the entire run is monitored. Sex and origin (wild or hatchery) of the Chinook salmon will be recorded as fish are censused during both video and broodstock operations. During broodstock collection, the age compositions of both the wild and hatchery-reared Chinook salmon components of the run will be evaluated. Broodstock of wild and hatchery-reared Chinook salmon will be collected and egg takes will be conducted in July. A hormone that accelerates and synchronizes the gamete maturation process in both males and females will be examined as a means to improve the efficiency of the broodstock operation. Gametes will be transported to the William Jack Hernandez Sport Fish Hatchery for fertilization and then reared to smolt for stocking the following spring. Smolt will be released in the Ninilchik River and 2 salt water locations in Kachemak Bay.

Key words: Ninilchik River, escapement, egg takes, Chinook salmon, *Oncorhynchus tshawytscha*, stocking, supplementation, Ovaplant

INTRODUCTION

PURPOSE

This project has 2 primary purposes: 1) monitor the wild Ninilchik River Chinook salmon escapement in relation to the escapement goal, ensuring the sustainability of the stock, and 2) conduct egg takes at the Ninilchik River weir to support the Ninilchik River and terminal saltwater stocking program, which provides additional fishing opportunities within the Ninilchik River and terminal saltwater fisheries in Kachemak Bay.

BACKGROUND

The Ninilchik River is located on the Kenai Peninsula in the Lower Cook Inlet management area (LCIMA) (Figure 1). It is a small (anadromous stream length is 81 river kilometers [RKM]), nonglacial, anadromous stream with extensive wetlands (122 km^2) and no large tributary lakes. It is possible for sport anglers to harvest a significant portion of the Ninilchik River Chinook salmon run because the stream is small and water conditions are typically favorable to good fishing success. In the mid-1980s, the Alaska Department of Fish and Game (ADF&G) Division of Sport Fish (SF) recognized that the Ninilchik River Chinook salmon stock was vulnerable to overharvest from the growing Kenai Peninsula sport fishery. In 1987, SF initiated a supplementation program for the Ninilchik River to create sustainable fishing opportunities by stocking hatchery-reared Chinook salmon smolt. Because of the supplementation program, 2 groups of Chinook salmon (wild and hatchery-reared) now return to the Ninilchik River, and this has added an additional level of complexity to the management of escapement and harvest of the stock. Since 1994, Ninilchik River Chinook salmon smolt have also been used in stocking programs in other areas of Lower Cook Inlet (see below).

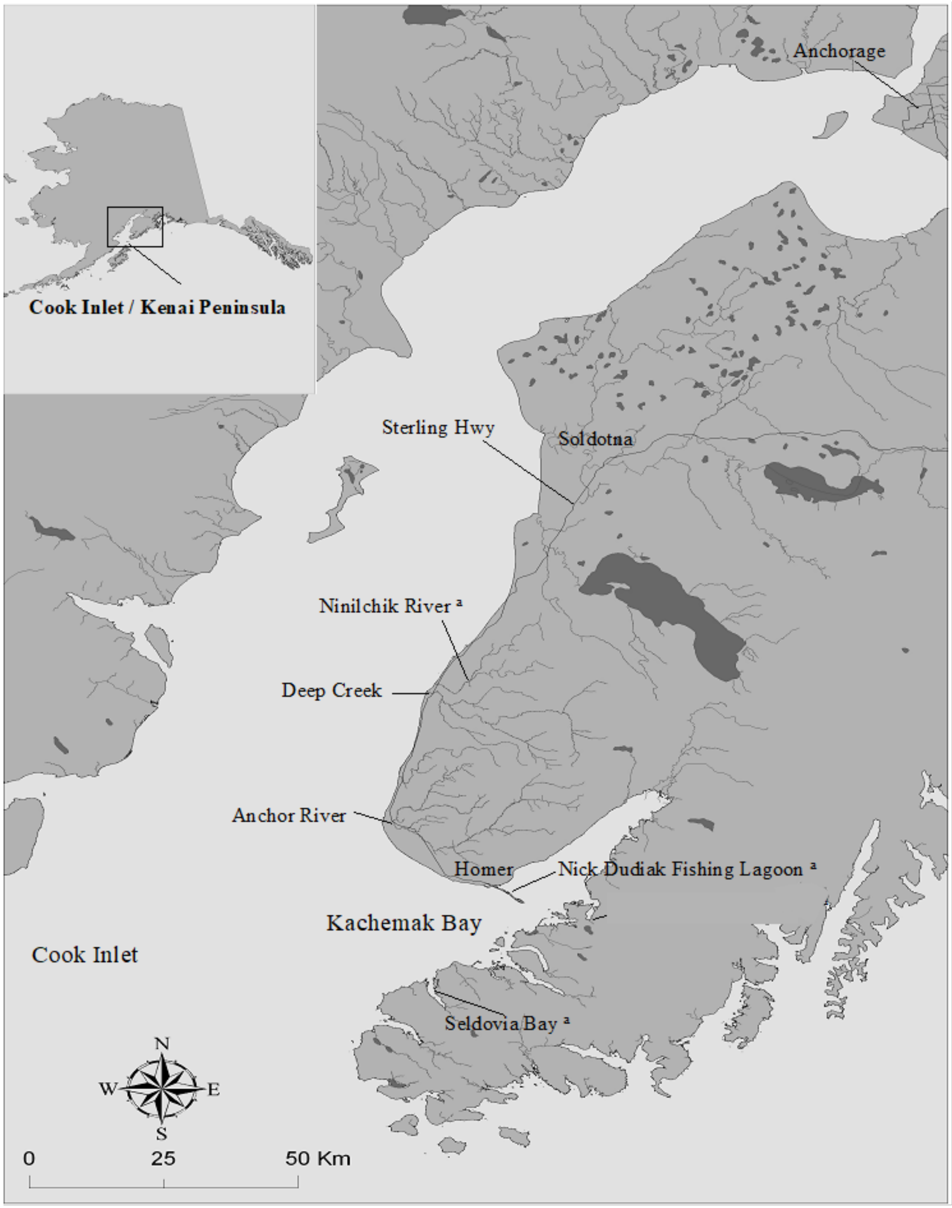

Figure 1.–Ninilchik River and Kachemak Bay Chinook salmon stocking locations, 2018.

[a] Indicates stocking location.

From 1999 through 2008, the average annual estimated harvest of Ninilchik River Chinook salmon was 1,387 fish (Booz and Kerkvliet 2016). This compares to an annual average of 2,197 wild and hatchery fish arriving at the weir from 1999 through 2005, when the weir operated for the duration of the run (Booz and Kerkvliet 2016). It should also be noted that a substantial proportion of the escapement, thought to be about 35%, spawns below the weir. From 2009 through 2015, the average annual estimated harvest of Ninilchik River Chinook salmon declined to 170 fish (Alaska Sport Fishing Survey database [Internet]. 1996–present. Anchorage, AK: Alaska Department of Fish and Game, Division of Sport Fish. Available from: http://www.adfg.alaska.gov/sf/sportfishingsurvey/) despite an average annual run to the weir of about 1,000 hatchery and wild fish during the month of July. During these years, sport fishing effort in the Ninilchik River also declined by over 70% compared to historical effort. These declines are probably linked to below-average Chinook salmon runs and EO restrictions to the sport fishery. Ninilchik River Chinook salmon harvest increased to 673 in 2016 and was associated with a weir count of 2,843 over the entire run. In 2017, 1,469 Chinook salmon were counted at the weir over the entire run.

Stocking Program

Ninilchik River

In 1987, the Ninilchik River Chinook salmon stocking program was initiated by collecting and fertilizing eggs from broodstock from the Ninilchik River and then rearing them to smolt in hatchery facilities in Anchorage. From 1988 to 1994, approximately 200,000 hatchery-reared Chinook salmon smolt were released at either Brody Road Bridge (RKM 7.7), Sterling Highway Bridge (RKM 2.0) or in the harbor just upstream of the river mouth. During these years, only a small portion (9–31%) of the hatchery-reared smolt were adipose-fin-clipped and injected with a coded wire tag (CWT). From 1995 through 2014, the annual supplementation of Chinook salmon for the Ninilchik River remained essentially unchanged with lower stocking levels of 50,000 smolt and with 100% of the smolt adipose-fin-clipped and thermally marked. From 1995 through 2010, all hatchery smolt stocked into the Ninilchik River were also injected with a CWT. The CWT program was discontinued throughout the Southcentral SF region from 2011 to 2014. In 2015, stocking levels were increased to 150,000 smolt with 100% of the smolt adipose-fin-clipped, thermally marked, and injected with a CWT. From 1996 through 2013, all hatchery-reared smolt were released at the Brody Road Bridge in mid-May to mid-June. Starting in 2014, the release site was moved to RKM 25.8. This new site was thought to increase distribution and duration of freshwater residency of hatchery-reared smolt in the Ninilchik River, which should increase imprinting, resulting in a larger portion of the hatchery-reared run returning to the weir site. Only the progeny from wild Chinook salmon broodstock are used for Ninilchik River stockings. From 1988 through 2002, Chinook salmon smolt were stocked as age-0 fish. From 2003 through 2011, due to limited hatchery rearing facilities, all stocked Chinook salmon were overwintered in the hatchery as parr and then released in the spring as age-1 smolt. Starting in 2012, all Ninilchik River hatchery Chinook salmon have been reared in the new William Jack Hernandez Sport Fish Hatchery (WJHSFH) in Anchorage and stocked as age-0 smolt.

Kachemak Bay Terminal Fisheries

ADF&G began stocking Chinook salmon in terminal saltwater locations of Kachemak Bay in 1974 to create additional sport fishing opportunities. Initially, Chinook salmon smolt were stocked in Halibut Cove Lagoon (HCL) but stocking was then expanded to Nick Dudiak Fishing Lagoon (NDFL) on the Homer Spit in 1984 and to Seldovia Harbor in 1987. Changes to the amount of stocking and methods have occurred at all Kachemak Bay terminal fishery locations. Additionally, various broodstocks have been used during the stocking program at all 3 locations.

Starting in 1994, additional broodstock from the Ninilchik River was collected to support stocking at the terminal saltwater fisheries in Kachemak Bay. Due to broodstock shortages at the Ninilchik River weir, a combination of broodstock from the Ninilchik River, Crooked Creek, and Ship Creek have been used to supply smolt for terminal saltwater fishery stockings since 2011.

Historically, smolt were held in net pens for 5 days prior to release at the terminal saltwater fishery locations. It was assumed that a 5-day holding period was beneficial for Chinook salmon smolt to imprint to their stocking location. NDFL has no freshwater inputs, HCL has a small second-order stream approximately 0.2 km west of the stocking location, and the slough feeding into the Seldovia Harbor has several freshwater streams. Smolt were also fed while being held in the net pens.

Since 2009, harmful algal blooms of the diatom *Chaetoceros* spp. have complicated the holding of smolt at NDFL and HCL. These diatoms are found as either individual cells or long chains of individuals linked together. Each cell has long spines that can lacerate the gill filaments of fish. Chinook salmon smolt held in pens are more susceptible to the harmful effects of *Chaetoceros* spp. because the nets do not allow the fish to avoid blooms. *Chaetoceros* spp. concentrations as low as 5,000 cells/L can be lethal to salmon held in net pens (Yang and Albright 1994). Plankton blooms are hard to predict, but blooms are generally influenced by the amount of sunlight and inputs of inorganic nutrients such as nitrate and phosphate[1]. *Chaetoceros* spp. concentrations can increase quickly to levels unsafe to hold fish (>10,000 cells/L) and then to bloom-like levels (≥1,000,000 cells/L).

In 2012, the risk from lethal concentrations of *Chaetoceros* spp. necessitated daily assessment throughout the stocking season. The goal was to identify changes in *Chaetoceros* spp. concentrations that would influence our ability to safely hold smolt in net pens. The assessment, which began on 17 April prior to stocking on 27 April, found initial *Chaetoceros* spp. concentrations well below 10,000 cells/L. On 28 April (1 day after stocking a small test group of Chinook salmon smolt), *Chaetoceros* spp. concentrations increased to bloom levels. This small stocking exhibited a high holding mortality and the smolt were released on 28 April. *Chaetoceros* spp. concentrations remained higher than 10,000 cells/L throughout most of the monitoring period into early August when sampling was terminated. There was a 5-day period from 13 to 17 July when concentrations decreased. However, after this period, *Chaetoceros* spp. concentrations averaged 377,000 cells/L through 5 August. Because of this high level, the remaining 3 stockings of 2012 were all released without holding.

In 2013, adaptive stocking methods were explored for releasing smolt when *Chaetoceros* spp. concentrations were at harmful levels. Instead of holding smolt in net pens for the traditional 5-day period or directly releasing them, smolt were temporarily stocked in net pens and held until they could be released in the dark (after midnight). This short holding period allowed smolt to stabilize from being transported and stocked, adjust to salt water prior to release, avoid daytime bird predation, and minimize exposure to *Chaetoceros* spp. After releasing the smolt, the nets were removed from the water, but the net pen covers and floats were left in place to give the smolt some relief from bird predation. The released smolt were also fed daily to encourage longer residence at the stocking location and ideally improve imprinting. This method was successful at reducing mortality caused by *Chaetoceros* spp. within net pens, reducing bird predation, and allowing the smolt to imprint to NDFL without being held in net pens. Due the prevalence of *Chaetoceros* spp. in NDFL, HCL, and Kachemak Bay, these adaptive stocking methods were used for all stockings in 2014 through 2017.

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[1] NOAA. 2010. Harmful algal blooms and biotoxins: phytoplankton–algal bloom dynamics. http://www.nwfsc.noaa.gov/hab/habs_toxins/phytoplankton/algal_dynamics.html.

Egg Take

Since 1988, broodstock collection and egg takes have been conducted at a broodstock weir located at Brody Road Bridge during the months of July and early August (Figure 2). From 2011 through 2015, wild Chinook salmon were not held for broodstock collection prior to achieving the sustainable escapement goal (SEG) due to the concern that the SEG would not be met if fish were used for broodstock. Prior to 2010, Chinook salmon held from early in the weir run rarely fully ripened to contribute to broodstock collection and often died, contributing unnecessarily to reductions in the escapement. Broodstock collection has been more successful (based on survival to eyed-egg stage) with fish collected later in the run. The inriver holding area works to hold Chinook salmon for only short periods until a sufficient number of mature fish are present to conduct an egg take (~30 pairs); the area is inadequate to hold and ripen Chinook salmon for long periods.

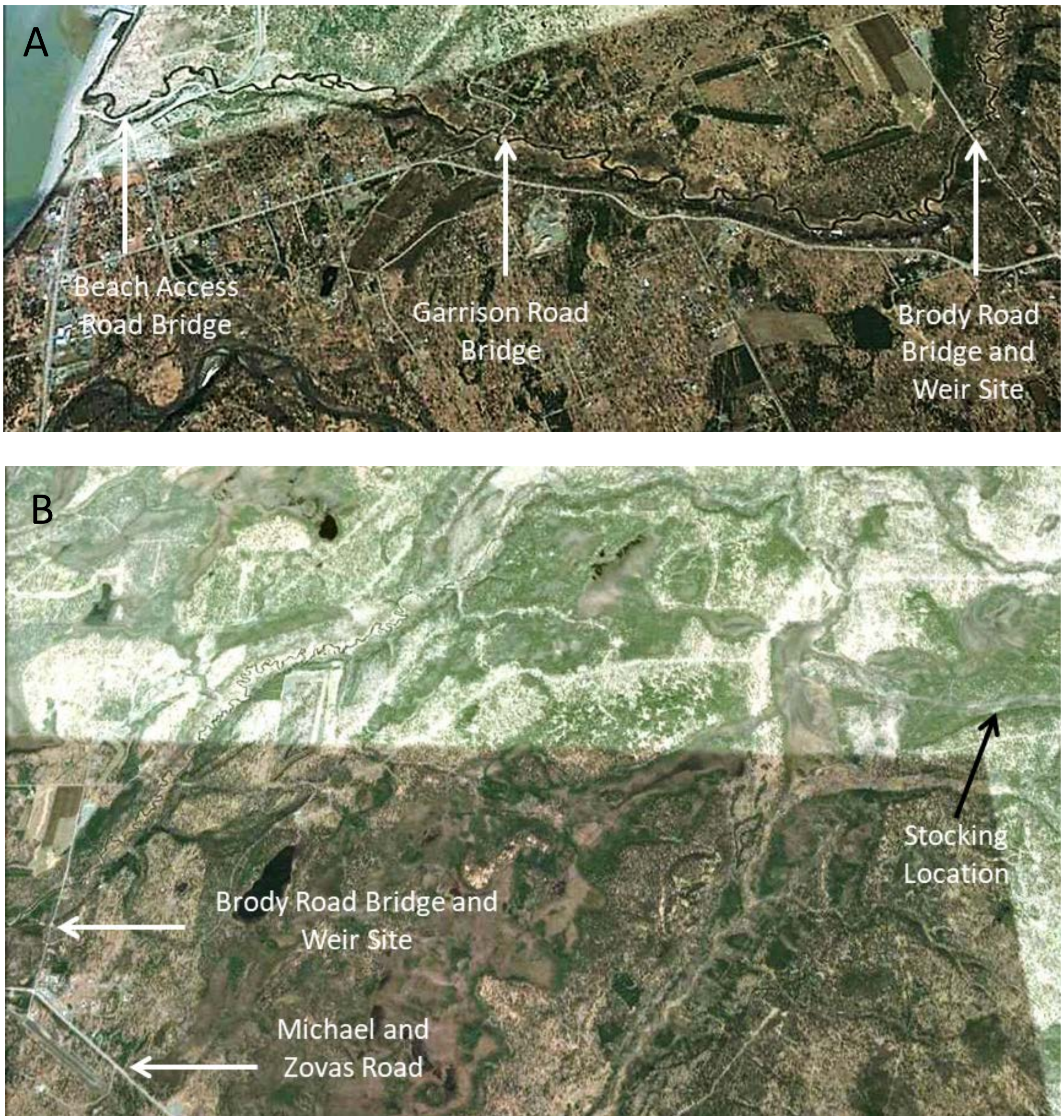

Figure 2.–Ninilchik River weir (A and B), water gauge site (A), and stocking location (B), 2018.

Although broodstock collection is more successful later in the run, there are costs in continuing to operate the weir into August, and there is the risk of genetic selection for later run timing. The hatchery-reared Chinook salmon run has consistently returned to the Brody Road weir site later than the wild run, and based on observations during broodstock collection, hatchery fish mature later than wild fish. These factors, coupled with below-average escapement, limited our ability to maximize the use of hatchery-reared Chinook salmon for egg takes in 2012 through 2015.

At the Ninilchik River weir in 2016 and 2017, the use of a gamete maturation hormone (Ovaplant[2]), was explored to see if maturation could be synchronized and accelerated, improving the efficiency of gamete collection. Although there were postinjection holding mortalities in 2016, some specific benefits were observed:

1) Maturation was accelerated for injected fish compared to noninjected fish during the early portion of broodstock collection.

2) Hatchery-reared females injected with Ovaplant reached maturity and produced viable gametes more often than noninjected hatchery-reared females.

3)Injection was also successful with males, allowing for synchronized maturation of both sexes.

In 2017, results from the use Ovaplant were similar, and the overall survival to eyed-egg stage was well above the historical average.

Monitoring

Escapement

ADF&G has monitored Chinook salmon escapement in the Ninilchik River since 1962. Starting in 1999, all hatchery-reared Chinook salmon returning to Ninilchik River have been adipose-fin-clipped. Since then, all weir counts of wild and hatchery-reared Chinook salmon have been differentiated by examining all Chinook salmon at the broodstock weir for the presence or absence of an adipose fin. From 2006 through 2015, the weir was only operated for broodstock collection from late June through early August and escapement was monitored during an index monitoring period (3–31 July; Table 1). The Chinook salmon escapement was calculated by removing the holding and egg-take mortalities from the Chinook salmon weir count. On average (1999–2005, when the entire run was monitored), 65% of the total wild Chinook salmon escapement upstream of the weir was counted during the index monitoring period. In 2016, underwater video within the broodstock weir was used to monitor Chinook salmon escapement prior to weir operation for broodstock collection. This equipment was similar to that successfully used on the Anchor River to monitor Chinook salmon escapement (Kerkvliet and Booz *In prep*). In 2017, the video monitoring system was also used to monitor the end of the run at the weir after broodstock collection was complete. The system proved to be a cost-effective way to monitor the entire run. Although the weir operation was expanded to the entire run, monitoring escapement at this location fails to account for spawning below the weir, which may include approximately 35% of the total spawning escapement based on aerial survey data; it is noted that the composition (wild vs. hatchery-reared) of the spawning population below the weir is unknown (Marsh *unpublished*[3]).

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[2] Product names used in this publication are included for completeness but do not constitute product endorsement.

[3] L. E. Marsh, 1997 memorandum to B. Clark, ADF&G, on preliminary evaluation of the stocking program at the Ninilchik River. Subsequently referred to as the *Marsh, memorandum*.

Table 1.–Wild and hatchery-reared Chinook salmon escapement counts and expanded weir count estimates, 1999–2017.

		Wild Chinook salmon					Hatchery-reared Chinook salmon				
					Total					Total	
Year	Operation dates	Estimated % of run monitored	Weir count	Expanded weir count [a]	Removals	Escape-ment [b]	Estimated % of run monitored	Weir count	Expanded weir count [a]	Removals	Escape-ment [b]
1999	18 May–13 Aug	100	1,644	NA	68	1,576	100	641	NA	68	573
2000	17 May– 8 Aug	100	1,634	NA	81	1,553	100	853	NA	168	685
2001	30 May–5 Aug	100	1,414	NA	175	1,239	100	673	NA	130	543
2002	23 May–11 Aug	100	1,516	NA	176	1,340	100	559	NA	164	395
2003	16 May–5 Aug	100	1,258	NA	131	1,127	100	425	NA	89	336
2004	18 May–5 Aug	100	1,525	NA	132	1,393	100	536	NA	67	469
2005	6 May–4 Aug	100	2,241	NA	165	2,076	100	462	NA	53	409
2006	30 Jun–1 Aug	74.5	1,139	1,530	101	1,429	83.7	260	311	34	277
2007	2 Jul–1 Aug	71.2	679	954	129	825	81.9	83	101	20	81
2008	30 Jun–7 Aug	75.8	772	1,019	140	879	91.6	83	91	30	61
2009	29 Jun–6 Aug	79.3	620	781	41	740	92.0	97	105	39	66
2010	1 Jul–1 Aug	73.1	623	852	0	852	82.6	34	41	0	41
2011	1 Jul–4 Aug	75.2	835	1,111	99	1,012	88.5	51	58	27	31
2012	29 Jun–9 Aug	77.2	609	789	26	763	92.5	65	70	21	49
2013	1 Jul–11 Aug	75.9	674	888	34	854	91.7	210	229	145	84
2014	1 Jul–31 Jul	72.3	990	1,369	92	1,277	80.6	1,116	1,385	1,026	90
2015	1 Jul–2 Aug	73.9	1,002	1,356	88	914	84.8	691	779	585	106
2016	1 Jun–7 Aug	100	1,676	NA	146	1,530	100	1,147	NA	437	710
2017	18 May–14 Aug	100	945	NA	90	855	100	524	NA	272	252
Averages											
1999–2005			1,605		133	1,472		593		106	487
2006–2015			794	1,065	75	955		269	317	193	89
2016–2017			1,311		118	1,193		836		355	481

[a] Weir counts of wild and hatchery-reared fish for 2006–2015 (partial enumerations) were expanded using data from 1999–2005, when the entire run was enumerated. The partial counts were divided by the average proportion of the total run counted during the partial run operation dates (estimated % of run monitored).

[b] The current wild Chinook salmon sustainable escapement goal is 750–1,300 fish upstream of the Brody Road Bridge weir.

Sustainable Escapement Goal

In fall 2016, the SEG range for the wild Ninilchik River Chinook salmon run was updated to 750–1,300 wild fish for the entire run. This SEG was established using the wild run escapement censuses from 1999 to 2005 and the estimated wild run escapement counts from 2006 to 2015 (Otis et al. 2016). From 2006 through 2015, annual escapement counts for the entire run were estimated using the weir count and an expansion factor based on the average portion of the run monitored for each year. These expansions resulted in 20–30% increases in weir run size, which were then converted to escapement counts by removing all mortalities that occurred at the weir.

Biological Sampling

Age, sex, and length data have been collected for both wild and hatchery components of the Ninilchik River Chinook salmon run at the broodstock weir since the inception of the stocking program. Historically, the hatchery-reared component of the run has been sampled as outlined below in the methods section for wild Chinook salmon. Small run sizes of hatchery-reared Chinook salmon dictated changes to the age and length sampling methodology from 2007 to 2012. The annual hatchery-reared Chinook salmon weir counts during these years were less than 100 fish so every hatchery-reared Chinook salmon was sampled for age and length. These runs were well below average. Small run size was attributed to below-average smolt size at stocking, coupled with poor marine survival. In 2013, the hatchery-reared Chinook salmon weir count during the SEG index monitoring period was 210 fish. Of those, 172 were small males (<525 mm mid eye to tail fork [METF]), most of which were jacks (ocean age 1) and the first returns from the WJHSFH. This run of jacks was the largest ever observed at the weir. This significant increase in jacks prompted an adjustment in age and length sampling methods in 2014 and 2015. Prior to 2014, the 550 mm METF length cutoff was used to classify jacks. In 2014 and 2015, the METF length cutoff was reduced by 25 mm to decrease the possibility of identifying an ocean-age-2 Chinook salmon as a jack. Hatchery-reared Chinook salmon <525 mm METF were subsampled for lengths, but no scales were collected from these fish, which were assumed to be ocean age 1. All hatchery-reared Chinook salmon ≥525 mm were sampled for age and length. Preliminary results suggest that estimating the number of ocean-age-1 males using the 525 mm cutoff may introduce bias due to age overlap at this size. In 2016, the size cutoff for jacks was adjusted to <508 mm (20 inches) total length (TL). This aligned the jack size cutoff with the measurement used for jack Chinook salmon in sport fishing regulations. This reduced size cutoff also decreases the likelihood that a small ocean-age-2 Chinook salmon is classified as a jack. In 2016 and 2017, hatchery-reared fish were subsampled, regardless of size, for age and length like the wild component of the run.

Reducing Hatchery-Reared Chinook Salmon Escapement

From 1999 through 2005 (when the weir was operated over the entire run and all hatchery fish were adipose-fin-clipped), the hatchery-reared contribution to the escapement above the weir averaged approximately 25% annually. The sport fishery was liberalized over these years to help reduce hatchery-reared Chinook salmon in the escapement. From 2006 to 2015, when the run was only partially monitored, the hatchery-reared contribution to the escapement above the weir averaged 8% during the SEG index monitoring period. This reduction was caused by a combination of factors, including poor hatchery returns due to poor quality stocked smolt, poor marine survival of hatchery fish, additional sport fishing opportunities for hatchery-reared

Chinook salmon, maximized use of hatchery fish in broodstock collection, and ad hoc removal of hatchery fish at the weir.

The first attempt to remove hatchery-reared Chinook salmon at the weir occurred in 2013, when the number of ocean-age-1 males at the weir increased significantly. This increase was partially due to increased production out of the WJHSFH. In the last few days of weir operation in 2013, 143 hatchery-reared jack Chinook salmon were removed. In 2014, the hatchery-reared jack Chinook salmon weir count was 821; substantial effort was required to remove them from the escapement throughout the weir operation and during maturity sorting in the egg-take operation (820 were removed in total). Egg-take operations in 2014 accounted for 77 hatchery-reared Chinook salmon removals. Additionally, 129 hatchery-reared males ≥525 mm were removed at the end of weir operation to further reduce the hatchery-reared contribution to the escapement to less than 10%. After egg takes were completed in 2014, five remaining hatchery-reared females were allowed to escape upstream of the weir. In 2015, 384 hatchery-reared jacks were removed from the escapement as they arrived at the weir and 88 large hatchery-reared males were removed from the escapement after they were not needed for broodstock collection. After all removals, including broodstock collection and holding mortalities, the hatchery-reared contribution to the escapement above the weir during operation was 10%. In 2016, despite removing 437 hatchery-reared fish during broodstock collection (which included culling 193 hatchery-reared males, sacrificing 151 hatchery-reared Chinook salmon for egg takes, and 93 holding mortalities), the hatchery-reared contribution to the total Chinook salmon escapement above the weir was 32%. Most of these hatchery-reared fish passed the weir site in the month of June. In 2017, 272 hatchery-reared Chinook salmon were removed from the escapement during broodstock collection, which included 153 hatchery-reared males culled, 69 hatchery-reared Chinook salmon sacrificed for egg takes, and 50 holding mortalities. Hatchery-reared Chinook salmon composed 23% of the total escapement above the weir because 252 fish were either not removed during broodstock collection or had passed the weir site during video operation.

CWT Collection

Since initiating stocking of hatchery-reared Chinook salmon in the Ninilchik River, the use and assessment of CWTs has varied. From 1988 through 1994, only a small percentage of each annual stocking was tagged with CWTs. This required expansion of recovered CWTs to estimate the number of hatchery-reared Chinook salmon in the run to the weir and in the inriver sport fishery. From 1995 through 2010, all hatchery-reared Chinook salmon smolt were tagged with CWTs prior to release. The Chinook salmon CWT program was discontinued regionwide starting with the first release from fish produced at WJHSFH in 2011. The Chinook salmon CWT program resumed in 2015 to support identification of hatchery-reared Cook Inlet stocks in the saltwater fisheries along the Kenai Peninsula. CWTs collected at the Ninilchik River weir have also been used to assess straying from other Cook Inlet stocking programs and to assess the accuracy of scale age estimates. Additionally, Ninilchik River hatchery-reared Chinook salmon have been detected through CWT recoveries throughout the Pacific Northwest in other sampling programs. The hatchery-reared Chinook salmon smolt stocked in the Ninilchik River in 2015 and 2016 were tagged with CWTs and were thermally marked. However, beginning in 2017, stocked hatchery-reared Chinook salmon only possess thermal marks.

Composition of Chinook Salmon within the Sport Fishery Area

From 2011 through 2017, a beach seine survey has been used to assess the origin, sex, and size (<508 mm or ≥508 mm TL) compositions of Chinook salmon present in the sport fishery area of the Ninilckik River (currently, the lower 3.2 RKM) prior to broodstock weir operation and the hatchery-only fishery. From 2011 through 2015, this assessment was needed because the weir was not operated prior to broodstock collection. In 2016 and 2017, a video weir was operated prior to broodstock collection and those counts provided an assessment of abundance and compositions. Unfortunately, the video weir counts could not sufficiently assess the compositions in the sport fishery area due to migratory timing from the sport fishery area to the weir.

In 2016 and 2017, the date of the beach seine survey was earlier than surveys conducted in 2011–2015 because the hatchery-only fishery opened in mid-June as opposed to 1 July in previous years. In 2017, a beach seine survey was also conducted in the sport fishery area prior to the first 3-day weekend fishery. These data provided information to do the following:

1) The hatchery-only sport fishery could be restricted or liberalized depending on whether the survey indicated a lack or abundance of hatchery-reared Chinook salmon, respectively.
2) The annual run strength index could be compared to recent years.
3) The origin, sex, and size compositions of the Chinook salmon run to the weir could be anticipated in relation to the SEG, egg take goals, and the hatchery-reared escapement.

Sport Harvest

Monitoring the Chinook salmon sport harvest at the Ninilchik River has become more complicated since the inception of the supplementation program. The ADF&G Statewide Harvest Survey (SWHS) estimates by area and fishery the participation, harvest (fish kept), and catch (fish harvested plus fish released) of sport-caught species. The SWHS does not estimate harvest by stock (wild vs. hatchery-reared) or by time period.

From 1991 through 2006, periodic assessment of the hatchery-reared contribution to the sport harvest has been conducted with creel and sport harvest surveys. These surveys found over 50% of the harvest was of hatchery-reared fish during both high and low stocking years (Balland and Begich 2007; Balland et al. 1994; Begich 2006, 2007; Boyle and Alexandersdottir 1992; Boyle et al. 1993; Marsh 1995; Marsh, memorandum). There was 1 exception to this pattern in 2006, when 39% of the Chinook salmon harvest was hatchery-reared during the 3 regulatory 3-day weekends of the fishery (Booz and Kerkvliet 2011a).

Despite Chinook salmon supplementation in the Ninilchik River, the Chinook salmon sport fishery was restricted through EO from 2010 through 2014 to reduce harvest to ensure adequate wild Chinook salmon escapement. In those years, the contribution of hatchery-reared Chinook salmon to the harvest in the sport fishery was probably well below the historical contribution. If only 40% of the sport harvest was of hatchery origin (e.g., 2006), then an average of about 80 hatchery fish have been provided annually to anglers from 2009 to 2015. The 2016 sport harvest of 673 Chinook salmon was greater than the 2009–2015 average and the largest harvest since 2008. The 2016 hatchery-reared contribution to the harvest was probably larger than in recent years because of an EO that extended the hatchery season to earlier in June.

Management

The sport fishery regulations for Ninilchik River Chinook salmon are designed to conservatively manage a sustainable wild stock while maximizing harvest of hatchery-reared Chinook salmon. Both emergency orders (EOs) and changes to the regulations through the Alaska Board of Fisheries (BOF) process have attempted to provide additional sustainable harvest opportunity for hatchery-reared Chinook salmon.

Current regulations restrict harvest opportunity by limiting the area open to fishing to the lower 3.2 RKM of the Ninilchik River (to protect the main Chinook salmon spawning area) and by limiting fishing openings for wild or hatchery-reared Chinook salmon to 3 consecutive 3-day weekends (Saturday through Monday) beginning on Memorial Day weekend. The bag limit is 1 Chinook salmon per day. From 16 June through 31 October, the bag limit is 1 hatchery-reared fish per day. The Cook Inlet annual Chinook salmon limit of 5 applies to fish harvested in the Ninilchik River.

OBJECTIVES

PRIMARY OBJECTIVES

1) Census the Ninilchik River wild and hatchery-reared Chinook salmon run and escapement[4] at RKM 7.7 from mid-May through early August.
2) Estimate the sex and age compositions of each of the Ninilchik River wild and hatchery-reared Chinook salmon runs at RKM 7.7 during the broodstock weir collection period such that the estimates of each group are within 10% of the true values 95% of the time[5].
3) Estimate the wild vs. hatchery-reared composition of the Chinook salmon run in the sport fishery area (the lower 3.2 RKM) in late May prior to the three 3-day weekend fishery and in mid-June, prior to the hatchery-reared only sport fishery such that the estimates of each group are within 10% of the true values 90% of the time.

SECONDARY OBJECTIVES

1) Census the sex compositions of the Ninilchik River wild and hatchery-reared Chinook salmon runs at RKM 7.7 from mid-May through early August.
2) Collect, hold, and artificially spawn 140 male and 140 female Chinook salmon during July from the Ninilchik River (minimum of 60 wild males and 60 wild females to ensure genetic variation) for future hatchery releases at the Ninilchik River, Seldovia, and the NDFL on the Homer Spit. Only progeny from wild fish will be used for stocking the Ninilchik River.
3) Release approximately 150,000 Chinook salmon smolt in the Ninilchik River, 105,000 smolt in Seldovia, and 315,000 smolt in NDFL from May through June.
4) Estimate length-at-age by sex for each of the Ninilchik River wild and hatchery-reared Chinook salmon runs at RKM 7.7.

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4 Run and escapement differ by the number of fish sacrificed for broodstock; hatchery fish may also be removed to lower the proportion of the escapement that is of hatchery origin.

5 "Within *d*% of the true value *A*% of the time" implies $P(p_i - d/100 \le \hat{p}_i \le p_i + d/100) = A/100$: for all *i*, where *pi* denotes population age proportion for age class *i*.

5) Census Ninilchik River wild and hatchery-reared Chinook salmon <508 mm total length (TL) in the Chinook salmon run at RKM 7.7 from mid-May through early August.
6) Observe results of using Ovaplant hormone to accelerate maturation of Chinook salmon used in egg takes.
7) Collect heads (CWTs) from hatchery-reared Chinook salmon sacrificed for broodstock collection to assess straying from other stocking locations into the Ninilchik River.
8) Collect kidney samples from all sacrificed female Chinook salmon from egg takes to test for Bacterial Kidney Disease (BKD).
9) Assess the accuracy and within-reader variability of age estimates.
10) Measure daily water temperature and depth at the weir.
11) Quantify *Chaetoceros* spp. concentrations around stockings at NDFL.
12) Determine smolt mortality rates in stocking net pens.
13) Measure water temperature and dissolved oxygen saturation during stocking activities.
14) Measure water temperature and dissolved oxygen saturation in broodstock holding raceways and the Ninilckik River while holding broodstock to maintain ideal holding conditions.

METHODS

STUDY DESIGN

There are 4 main components to this project: 1) escapement monitoring and biological sampling, 2) broodstock collection, 3) smolt releases, and 4) estimation of Chinook salmon run composition (wild vs. hatchery-reared) in the Ninilchik River sport fishery area.

The Ninilchik River Chinook salmon escapement will be monitored at a weir installed at approximately 7.7 RKM from the mouth and 15 m downstream of the Brody Road Bridge (Figure 2) from late May through mid-August. Biological sampling and egg takes will occur in July and early August at the weir site. Beginning in late May, hatchery personnel and Homer ADF&G staff will release smolt directly into the Ninilchik River at RKM 25.8 and stock smolt into net pens at the terminal saltwater fisheries in Kachemak Bay. A beach seine survey to collect composition data will be conducted in the Ninilchik River in May and mid-June.

Escapement Monitoring and Biological Sampling

Weir Operation

A fixed-picket weir will be used to monitor Chinook salmon escapement from mid-May through approximately 8 August. Escapement monitoring through the weir will vary between the broodstock collection period and when the weir is solely operated for escapement monitoring. An underwater video system will be used to census escapement before and after the broodstock collection operation (Figure 3). During the broodstock collection period, Chinook salmon will be counted as they are processed through the live box (Figure 4).

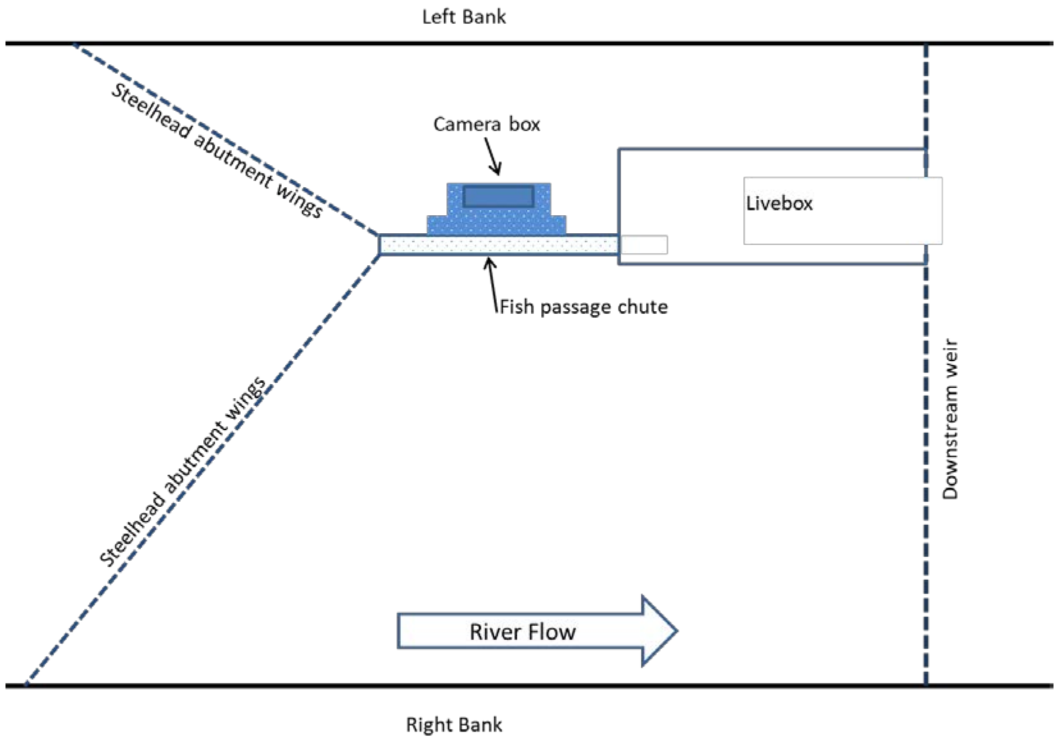

Figure 3.–The configuration of the Ninilchik River weir during video operation, 2018.

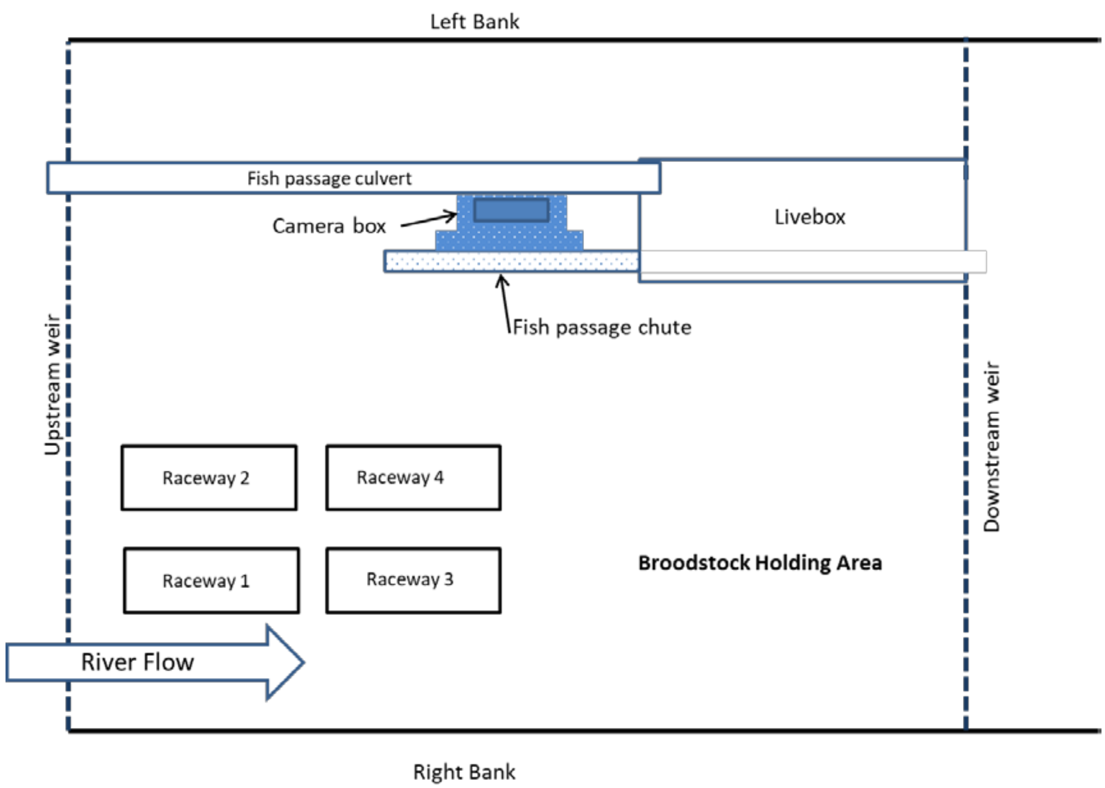

Figure 4.–The configuration of the Ninilchik River weir during broodstock collection, 2018.

Weir operation outside broodstock collection period

In mid-May, a fixed-picket weir will be installed at the Brody Road weir site. The weir is approximately 15 m long and will be constructed with panels that are 1 m tall by 4 m long supported with 5 cm IPS[6] steel pipe framing. The weir panels will be filled with 2 m long by 13 mm wide solid metal pickets every 26 mm to create 13 mm picket spacing. The pickets will be pushed through the panel into the substrate. Sand bags will used to prevent scouring along the base of the weir. Additionally, wings will be attached to the upstream end of the video fish passage chute to encourage downstream passage of emigrating steelhead (*O. mykiss*) (Figure 3).

Underwater video equipment will be fitted into the weir on the upstream end of the live box to monitor Chinook salmon escapement. During this time, no crew will be stationed at the weir site, but the weir site will be visited as needed to accomplish the following:

1) Visually inspect the weir to ensure no fish can migrate upstream undetected.

2) Clean the weir of all debris.

3) Ensure that the video system is recording and operating properly.

4) Switch out external hard drives to review the video footage.

The status of the weir and video system will be inspected more frequently through remote viewing access with a wireless internet connection. The remote access makes it possible to count daily fish passage via the video monitoring system, as well as ensure the video system is operating continuously. Security camera footage can also be accessed remotely, which makes it possible to remotely assess water level and debris on the weir.

The underwater video system is composed of an underwater camera mounted in a sealed box, a fish passage chute, a 12-VDC power system, and a video recording system. The camera box is roughly 80 cm by 90 cm and is constructed with 3.2 mm aluminum. The camera mounts in the rear and at the bottom of the camera box and is pointed towards the front through a 9.5 mm thick safety glass 45 cm by 80 cm in size. Approximately six 20 W halogen lights are installed within the camera box for consistent 24-hour illumination.

After the camera and lights are installed, the camera box is filled with dechlorinated tap water through a hatch to sink the camera box and to optimize video quality regardless of river turbidity. The hatch is located on the top of the box above the camera and sealed with a rubber gasket and bolts to prevent any river water or silt from entering the box. The camera and light cords are fed through a sealed tube on top of the camera box that extends well above the water line. The fish passage chute is roughly 1 m long, has a removable lid to block out most light, and restricts passage down to roughly 20 cm. The removable lid allows the outside of the camera box glass and the inside of the fish passage chute to be periodically cleaned. The backdrop of the fish chute will be marked with 2 vertical lines 508 mm apart that will allow categorization of Chinook salmon into 2 size groups (<508 mm and ≥508 mm TL). The camera box will be attached to the side of the fish passage chute.

The camera, lights, and DVR will be powered with shore-based electricity through a transfer switch that will allow the system to be powered by a backup system during power failures. This backup system includes up to 600 ah of battery, a 600 W inverter, and a 100 amp battery charger

[6] Iron pipe size, a standard industry measure.

(powered by shore-based electricity). The transfer switch automatically returns to shore-based power when it restores. The camera will be plugged into the video recording system, which consists of a DVR capture card within a desktop computer. All video images will be recorded on a 2-terabyte external hard drive at 30 frames-per-second. Motion detection software provided by the DVR manufacturer will be used to minimize the amount of blank video footage and review time. The camera will be split into multiple recording channels on the DVR. One channel will record only motion triggers and a second channel will record video footage 24 hours per day. The 3:00 AM hour will also be reviewed for the entire hour every day to ensure that each fish triggered a motion detection recording. In the event the motion detection software did not record a Chinook salmon, the motion detection settings will be immediately altered, and the full recorded footage will be reviewed for other missed triggers up to that point. All video files will be reviewed using GeoVision software provided by the DVR manufacturer. The security camera will be used to monitor water and debris conditions on the weir and will be viewable on one of the DVR channels. Use of GoToMyPC Remote Access software will allow staff to remotely access this computer via a WiFi connection created on a MiFi.

Escapement counting via video monitoring

All video clips of fish will be examined to identify species, adipose-fin clips, sex, and size class. Chinook salmon with intact adipose fins will be recorded as wild, and those with missing adipose fins will be recorded as hatchery-reared. Chinook salmon will be identified as male or female using external characteristics. All Chinook salmon video clips will also be examined to identify the fish as small (<508 mm TL) or large using the vertical markings on the backdrop of the fish passage chute. Chinook salmon counts by upstream or downstream movement, wild or hatchery-reared origin, male or female, and small or large fish will be tallied by hour and day. Other species will be tallied only by day.

Weir Operation During Broodstock Collection Period

At the end of June, the video system will be turned off and the live box will be used to capture fish. An upstream weir will be installed to create a broodstock holding area. A plastic corrugated culvert will be stretched from the end of the live box through the upstream weir to reduce time needed to pass fish upstream. An electric water pump will be used to supply water in the culvert. The gate to the live box will be opened daily at approximately 8:00 AM and closed around 11:00 PM. A technician will be stationed on site and will periodically check the live box and process all fish as quickly as possible to prevent impeding the migration during weir operation hours. The weir will be cleaned and visually inspected daily to ensure no fish migrate upstream undetected. The weir will be operated in this fashion throughout the broodstock collection period in July or until the egg-take goal is achieved.

Escapement counting via live box

All fish captured in the live box will be examined to identify species, adipose-fin clips, caudal clips, sex, and size class. All fish except Chinook salmon will be tallied and passed upstream. Chinook salmon with intact adipose fins will be recorded as wild, and those with missing adipose fins will be recorded as hatchery-reared. All Chinook salmon will be classified as either small (<508 mm TL) or large. All Chinook salmon captured in the live box will be given an upper-caudal-fin clip to prevent double sampling in the event of a weir failure. Captured Chinook salmon will be sexed based on external characteristics. Chinook salmon escapement will be calculated by summing the daily weir counts and subtracting all mortalities including those associated with processing through the live box, broodstock collection, and other ad hoc removals from the escapement.

Biological Sampling

During the broodstock collection period, Chinook salmon will be processed through the weir following the flow chart in Appendix A1 and sampled for age, sex, and length (ASL) using the following methods:

1) Age will be determined for each sampled Chinook salmon using 3 scales removed following the methods of Welander (1940) and as described in Appendix A2.
    a. If regenerated scales are present on the fish's left side in the preferred area, then the right-side preferred area will be used as an alternate. Common problems encountered with inexperienced scale collectors are listed in Appendix A3. Scale cards will be labeled with species, date, location, card number, and name of sampler before collection. To prevent confusion, the same scale card will be used for both wild and hatchery-reared Chinook salmon. The cards will be numbered sequentially from 1 through 99.
    b. Gum cards will be impressed into cellulose acetate using a Carver press at 99°C and 22,500 psi for approximately 2.5 min in the Homer ADF&G office. Scales will be read using a microfiche reader and aged with methods described by Mosher (1969). (Appendix A4). Age estimates will be produced without knowledge of size, sex, or other age estimates. Scale samples will be aged twice to estimate within-reader precision. All scale samples with conflicting ages for the 2 estimates will be re-aged to produce a resolved age used for composition and abundance estimates.
2) Sex will be determined by external physical characteristics, such as kype development, or a protruding ovipositor.
3) Length (METF) will be measured to the nearest 5 millimeters.

Sample Sizes

Sample sizes giving the desired precision for estimates of proportion by age for the wild run were calculated by combining a finite population correction factor (Cochran 1977) with the sample size determined under the assumption of multinomial sampling (Thompson 1987):

$$n = \frac{n_o}{1 + \frac{n_o - 1}{N}} (1 - R)^{-1}, \tag{1}$$

where

n_o = 127 Chinook salmon (Thompson 1987) from the target population,

N = total number of Chinook salmon in the target population, and

R = proportion of unreadable scales.

During the broodstock collection period, the latest 3-year average (2015–2017) run of wild Chinook salmon to the weir was 692. Assuming the run in 2018 is similar, and assuming age cannot be estimated on 20% of the scale samples, a sample of 135 wild Chinook salmon will allow us to meet the criteria stated in Objective 2.

Because the age and sex composition of the wild Chinook salmon run to the weir during the broodstock collection period may change throughout the run, age and length sampling will be conducted every other day by applying a sampling rate to the cumulative wild Chinook salmon weir count since the last sampling event. To determine the wild Chinook salmon sampling rate, we anticipate the wild Chinook salmon run to the weir in July will be the average of the last 3 years (692) and therefore anticipate that the required sampling rate will be at least 0.20 (135/692). For each sampling event, the number of wild Chinook salmon that arrived at the weir on the previous day will be multiplied by the sampling rate (0.20) and rounded up to the nearest whole number. Sampling will start immediately in the morning when the live box is opened and wild Chinook salmon will be sampled continuously until the sample size is met.

In 2018, the hatchery-reared Chinook salmon run will be composed of a full complement of age classes from fish reared at WJHSFH, which could increase the run size to the weir. Based on the 2015–2017 runs of hatchery-reared Chinook salmon to the weir during the broodstock collection period, the 2018 run will probably need to be sampled for age and length similar to the wild component sampling protocol. There may also be a substantial increase in the number of hatchery-reared ocean-age-1, -2, and -3 fish in 2018 due to the 150,000 fish stocking in 2015–2017. We anticipate about 464 hatchery-reared Chinook salmon (based on the average run size for 2015–2017 and the anticipated increase in ocean-age-1, -2, and -3 fish) will return to the weir during broodstock collection in 2018. Using a 20% regeneration rate for readable scales, and a finite population correction factor, the target sample size goal that meets Objective 2 criteria is 125 hatchery-reared Chinook salmon. The sampling rate will be 0.27 (125/464) applied to the hatchery-reared run in the same fashion as the wild run and will be sampled regardless of fish size.

Water Temperature and Stage Height

Water temperature (°C) will be recorded every hour at the weir site using a HOBO Tidbit Data Logger. Temperature data will be downloaded via a USB connection once per shift by the technician on duty. Stage height (ft) will be recorded every hour by the National Weather Service, Alaska Pacific River Forecast Center (RFC) at the Beach Access Road Bridge (RKM 1.32; Figure 2) via an automated gauge.

Broodstock Collection

An inriver holding area will be established using a weir upstream of the lower escapement weir to hold broodstock for gamete collection (Figure 4). Additionally, 4 raceways will be installed within the inriver holding area to explore the use of the Ovaplant hormone. With an egg-take goal of 140 pairs and a prescribed minimum 60 wild pairs (for genetic purposes), we would ideally use 80 hatchery-reared pairs. This arrangement should reduce the hatchery-reared contribution to the Chinook salmon escapement upstream of the weir and minimize the loss of wild escapement. Only wild broodstock are used to stock the Ninilchik River, whereas a combination of wild and hatchery-reared broodstock are used for stocking the terminal fisheries in Kachemak Bay.

In 2018, we will not hold wild Chinook salmon until we have met the wild SEG, or until we are reasonably close to the SEG and have confidence that wild fish will continue to arrive at the weir in sufficient numbers to comfortably meet the SEG. By counting the entire run, more information is provided to assess the run in season and to identify any potential conflicts between achieving the SEG and egg-take goals. The date when the weir count of wild fish has exceeded the lower end of the SEG has been quite variable in recent years (26 June in 2016 vs. 22 July in 2017). Despite this, we anticipate exceeding a weir count of 750 wild Chinook salmon by 10 July, which is the average date the weir count of wild fish has exceed the lower end of the SEG during years of full weir operation (1999–2005 and 2016–2017). If the run progresses as expected, we will begin holding wild fish near the 10 July date. All hatchery-reared Chinook salmon ≥508 mm TL will be held for gamete collection. The holding area will contain no more than 200 Chinook salmon at any given time and an approximate 1:1 sex ratio will be maintained for wild Chinook salmon. We anticipate there will be more wild males than wild females at the beginning of the broodstock collection period, so more wild males will be passed upstream during this time.

Ovaplant

Instead of collecting broodstock from earlier in the run and waiting for natural maturation, an alternative approach is to use the Ovaplant hormone during broodstock collection. Ovaplant is a single injection pellet implant of salmon gonadotropin1, which is a releasing hormone analogue (sGnRHa). Ovaplant mimics the natural peptide released from the cells of the hypothalamus and binds to the receptor cells of the pituitary gland that induces and maintains maturation. Ovaplant has been used in salmonid hatcheries to accelerate the maturation process and synchronize spawning and is equally effective on both males and females.

In 2018, we will determine if Ovaplant can be used with Ninilchik River broodstock collection to do the following:

1) collect gametes from broodstock held prior to ripening
2) help complete egg takes by 31 July
3) minimize the number of egg takes
4) maximize the use of hatchery-reared fish

Use of Ovaplant may also help compensate for the delayed maturation of Chinook salmon due to the stresses of handling and confinement in the holding area. It is hoped that Ovaplant will eliminate the need to handle fish to assess maturity.

To use Ovaplant, a permit is required from the United States Fish and Wildlife Service (USFWS) through the Investigational New Animal Drug (INAD) program. A major stipulation of the permit requires that fish injected with the hormone may not be released back into the wild. This restriction requires the use of raceways with locking lids within the holding area to ensure that fish do not escape. The holding area boundary will function as a secondary buffer to keep fish from escaping back into the river. Additionally, all Chinook salmon injected with Ovaplant will be tagged or caudal-fin clipped to aid in identification. Because fish injected with Ovaplant may not be released back into the wild, they will be removed from the escapement and will not count towards the SEG. Because the United States Food and Drug Administration (FDA) does not consider fish injected with Ovaplant fit for consumption, they require these fish to be destroyed after use.

The number of fish used in each Ovaplant treatment will be limited by the number of fish that can be safely held in the raceways (up to 40 fish per raceway). The treated fish will be divided approximately evenly between 4 raceways to maximize holding space. Each raceway will contain both males and females. The raceways may be further divided into hatchery-reared vs. wild Chinook salmon to aid in organization and tracking of treated fish.

The first Ovaplant treatment will occur once we have approximately 80 Chinook salmon pairs (both males and females will be injected). Ideally, the first treatment would include 60 wild pairs needed to meet objectives, but a combination of wild and hatchery-reared fish may be used if not enough wild fish are available. To synchronize maturation, all fish will be injected on the same day.

It is difficult to anticipate the date of the first treatment based on average daily counts of females to the weir because of variation in run timing during video operation and live-box operation. The first Ovaplant treatments occurred on 11 July in 2016 and 13 July in 2017; based on those dates and the average daily counts of females at the weir from 2005 to 2017, we anticipate the first Ovaplant treatment will occur after 10 July. Chinook salmon should be ready to spawn within 8 days after the Ovaplant treatment. Based on maturation timing after injection in 2016 and 2017, it is likely the first batch of treated fish will be ready to spawn 5–6 days after treatment.

The second Ovaplant treatment will occur immediately after the first egg take. Assuming males will be mature and ready for gamete collection naturally, the second treatment will ideally comprise only hatchery-reared females. This plan was not possible for the second Ovaplant treatments in 2016 and 2017. However, this approach should help accomplish the egg-take goal in the fewest number of egg takes by the end of July, minimize the loss of wild escapement and the contribution of hatchery-reared fish to the escapement, and maximize the use of hatchery-reared fish. This approach may fail, however, if an insufficient number of hatchery-reared females are available by the date of the second Ovaplant treatment, male Chinook salmon are not completely mature without the use of Ovaplant by the date of the second egg take, or the wild run is insufficient to meet the SEG after the egg take removals. Therefore, an adaptive approach will be used with the second Ovaplant treatment to provide maximum flexibility. Based on observations of Chinook salmon maturation during broodstock collection at the Ninilchik River weir after using Ovaplant in 2016 and 2017, it is likely that the time to maturation from treatment for the second egg take will be shorter than that of the first egg take. This will require female maturity to be assessed sooner after the second treatment so that fish may be spawned in a timely fashion. In addition to the broodstock used in the Ovaplant treatments, fully mature (or maturing by the next anticipated egg-take date) untreated fish will be used as needed to achieve the egg-take goal.

For each treatment event, fish will be captured from within the holding area using both a seine and dip nets and placed into a net pen approximately 3.57 m^3 (1.8 × 2.1 × 0.9 m) within the holding area. All Chinook salmon in the net pen that won't be in the treatment group will be released back into the holding area as quickly as possible. A cradle within a raceway will be used to hold fish during injection of Ovaplant. A "ralgun" with a sterilized needle will be used to inject the 75 µg Ovaplant pellet into the dorsal sinus cavity. The ralgun will be disinfected with a 3% iodophor solution (Betadine) between fish.

After treatment, each fish will be placed into a 20 m^3 raceway. Injected salmon will be held at a density of no more than 1 fish per cubic meter in each raceway (based on average fish size of 6.8 kg per fish and a recommended density of 8 kg/m^3). Liquid oxygen will be used as needed to maintain greater than 90% dissolved oxygen saturation in each raceway. Any injected Chinook salmon that die prior to being spawned will be examined and recorded on a necropsy report form for USFWS INAD reporting purposes. The number of treated fish by origin and sex will be tallied and tracked within each raceway (Appendix B3). The holding mortalities in each raceway will also be tallied daily by origin and sex until egg-take day. The number of spawned, spawned but green, and unused fish will be recorded by individual raceway for each treatment event as well. Tracking these numbers in season will assist with providing the required data to the USFWS INAD program.

Water Temperature and Dissolved Oxygen

During broodstock collection at the weir, water temperature (°C) and dissolved oxygen (DO) concentration (mg/L) will be collected using a hand-held YSI unit. To ensure adequate holding conditions, temperature and DO measurements will be collected in each raceway and the river throughout the day. When the water temperature increases, DO saturation will decrease, requiring increased use of supplemented liquid oxygen in the raceways. These measurements, along with a record of the number of salmon in each raceway, will be used to assess raceways holding differing numbers of Chinook salmon, and the corresponding DO saturation and liquid oxygen supplementation needs.

Egg Takes

For each egg take, gametes will be collected at the weir site, but fertilization will be delayed until gametes are transported to WJHSFH in Anchorage. All fish treated with Ovaplant and all hatchery-reared fish used in egg takes will be sacrificed. Any wild males not injected with Ovaplant but used in the egg takes will be live spawned and released upstream. Females will be placed head down on a bleeding rack and will be bled by cutting the lower dorsal artery and vein from the ventral side of their caudal peduncle to prevent blood from being mixed with the eggs. The abdomen and ovipositor of all sacrificed females will be disinfected with 3% iodophor solution (Betadine) and wiped clean before egg collection. To collect the eggs, each bled-out female will be held above a container holding a sealable egg bag and then her abdomen will be cut open from the vent to the gill plate. Loose eggs will then be collected in the bag. Sacrificed males will not be bled or cut open to collect gametes. Milt will be squeezed out of all males and temporarily collected in small wax-coated paper cups and then transferred to whirlpaks. Both egg bags and whirlpaks will be individually numbered for tracking purposes. Origin, Petersen tag number, METF length, and egg-bag number will be recorded for every female used in the egg take (Appendix B4). Finally, the gametes will be packaged in a cooler chilled by ice and fitted with a board to separate gametes from the ice before transportation to WJHSFH by hatchery staff.

Kidney samples will be collected from all sacrificed female Chinook salmon to test for BKD. A small spoon will be used to remove 2 small (1 × 1 × 1 cm) pieces of kidney: 1 from the anterior end and 1 from the posterior end of the kidney. The combined kidney samples from each fish should weigh about 1–2 g and will be placed in a whirlpak bag and labeled with the sample location, date, and corresponding egg-bag number. The spoon will be wiped clean of all tissue and disinfected with 3% iodophor solution (Betadine) between sampling each fish. All samples will be placed on ice and transported by hatchery staff to the pathology laboratory in Juneau.

Reducing Hatchery-reared Chinook Salmon Escapement

Due to the 200% increase in the number of hatchery-reared Chinook salmon stocked in 2015–2017 and the well below-average annual sport fishing effort in recent years, we anticipate needing to continue to remove hatchery-reared Chinook salmon from the escapement in 2018. ADF&G genetics policy states that no more than 10% of the escapement should consist of hatchery-reared Chinook salmon; this stipulation is meant to minimize the effects of hatchery-selectivity on juvenile survival.

All hatchery-reared fish <508 mm TL will be removed from the escapement as they are processed through the live box (Appendix A1). All other hatchery-reared Chinook salmon will be held for egg takes and additional fish will be removed from the escapement so that the hatchery-reared contribution to the escapement above the weir during broodstock collection is less than 10%.

CWT Collection

In 2018, only ocean-age-2 and -3 hatchery-reared Chinook salmon returning to the Ninilchik River will have CWTs (smolt were released with CWTs in 2015 and 2016). Releases from 2014 (ocean-age 4) and 2017 (ocean-age 1) were only thermally marked. CWT samples (heads) will be opportunistically collected from hatchery-reared Chinook salmon sacrificed during egg takes. If the egg take goal is met, up to 160 CWT samples may be available. An individually-numbered CWT cinch strap will be attached to each collected head. Prior to shipping the head samples to the ADF&G Mark, Tag, and Age Laboratory in Juneau, all samples will be scanned with a hand-held CWT detection wand. Only head samples that test positive for a CWT with the wand will be sent to the laboratory.

Stocking

Smolt will be transported from WJHSFH to the Homer area in a tanker truck with either 5 or 6 separate tanks. Hatchery staff will ensure DO, CO_2, and water temperatures are at appropriate levels for smolt.

Water Quality Sampling

At each stocking, a handheld YSI meter will be used to monitor water temperature and DO saturation. These data will also be collected at all smolt feedings and releases at NDFL. Additional measurements may be collected at all Kachemak Bay stocking locations if a significant mortality event occurs ($\geq$1% cumulative mortality; see mortality assessment section below). The probe to the YSI unit will be lowered to approximately 1 m below the surface and the measurements will be collected after the unit has stabilized. Ideally, water conditions for smolt are water temperatures below 16°C and dissolved oxygen saturations exceeding 80% (8 mg/L).

Ninilchik River

Hatchery staff, Homer staff, and CIRI personnel will coordinate the direct release of approximately 150,000 Ninilchik River Chinook salmon smolt at about RKM 25.8 (lat 60.059138°N, long −151.443371°W) near a bridge over the Ninilchik River located 6.4 miles down Michael and Zoyas Road, the turnoff of which is located at approximately milepost 3.75 Oilwell Road (Figure 2). The stocking will occur in late May and smolt will be allowed to emigrate freely.

Kachemak Bay Terminal Fisheries

The stocking of Chinook salmon smolt at 2 terminal fishery locations in Kachemak Bay will be coordinated by Homer staff, hatchery staff, a barge operator, and the Seldovia City Manager. The State of Alaska Marine Highway ferry will be used to transport the tanker truck to Seldovia. Approximately 210,000 Chinook salmon smolt will be stocked at NDFL in 2 separate stockings of roughly 105,000 smolt each. Approximately 105,000 Chinook salmon smolt will be stocked in Seldovia in late May or early June.

In Seldovia, Chinook salmon smolt will be released directly into the northern end of Fish Creek Slough and allowed to freely emigrate to the harbor. The Seldovia stocking location is approximately 2 km from the bridge over the slough near the harbor. The slough has several small freshwater inputs and always has enough water to allow smolt to emigrate to the harbor even at low tide.

At NDFL, smolt will be temporarily stocked into net pens and then released during the dark hours (midnight to 5:00 AM). This short holding period gives smolt the opportunity to adjust to salt water prior to release, gives cover from bird predation, and minimizes the risk of impacts from *Chaetoceros* spp. This method has been successfully used at NDFL since 2013. Smolt may be held in net pens longer but only if *Chaetoceros* spp. concentrations are below 10,000 cells/L at the time of stocking and if bloom levels near the stocking location have not been detected by the Kachemak Bay Research Reserve phytoplankton sampling program up to that point (see methods below in “Plankton Sampling” section).

Floating net pens will be deployed in the deepest water available, in the southwest corner of NDFL (Figure 5). The pens will consist of aluminum floats (8.5 m long, 0.6 m wide, and 0.3 m tall) braced together with 2 × 6 inch boards and plywood walkways. Three nets (8.53 m long, 4.27 m wide, and 3.66 m deep) will each provide a volume of approximately 200 m^3 to hold the smolt. The nets will be attached to the inside of the braced floats. After smolt are stocked into the pens, each pen will be covered with netting to reduce bird predation.

The NDFL floating net pens will be anchored offshore on the ends of each float with large anchors in 3 corners and smaller anchors at the other locations. A running line will be placed at the nonanchored corner to allow Homer staff to access the pens using a skiff. Between stockings, the nets will be removed and washed to improve water flow. A hose will be used to move the smolt from the stocking truck to the pens. Additional floats will be used to support the hose across the open water between the pens and shore. Smolt will be stocked at a density of no more than 6 kg fish/m^3. The estimated average weight per smolt will be used to calculate the appropriate number of smolt per pen, and fish from each tank of the stocking truck will be divided equally among the floating net pens. For each stocking, excess smolt will be directly released to open water. The approximate number of smolt will be recorded for each floating net pen.

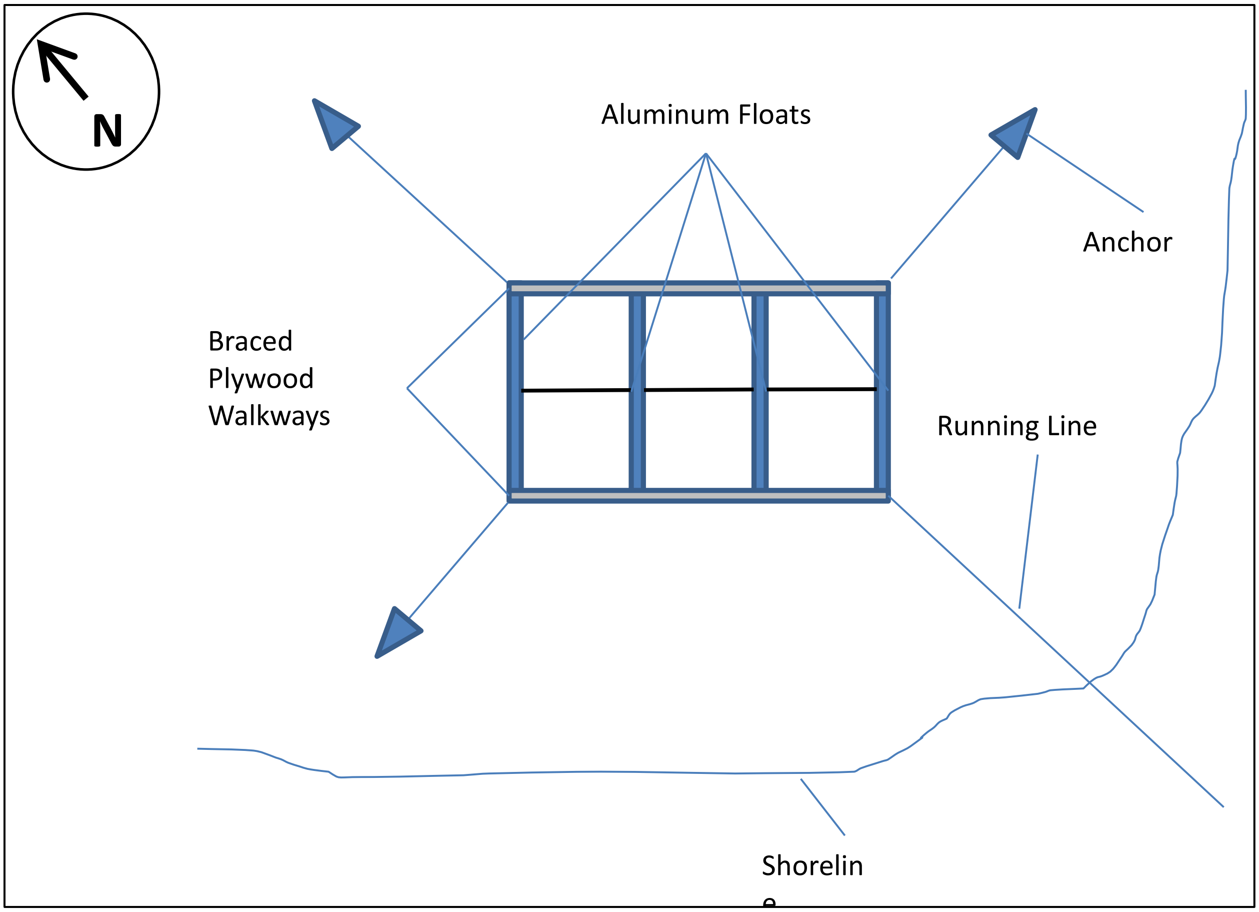

Figure 5.–Configuration of net pen assembly at the Nick Dudiak Fishing Lagoon, 2018.

Holding mortality assessment

A mortality assessment of smolt held at the NDFL net pens will be conducted by Homer staff when the smolt are released. Homer staff will pull the nets up onto the floats in such a fashion that allows them to collect dead smolt that have settled to the bottom. The number of mortalities will be counted in each net pen. The net covers will remain in place over the framed-out anchored floats, providing space for live smolt to remain under the floats and escape bird predation. If smolt are held in net pens for more than just overnight, the daily number of mortalities will be enumerated for each pen each morning prior to feeding by removing the net covers and pulling one side of each net pen to the surface. This action will typically bring dead smolt up to the surface where they can be captured using a long-handled dip net. Once the majority of dead smolt are captured, the net pen will be released as quickly as possible to allow smolt to disperse throughout the entire floating net pen.

For instances when smolt are held beyond the first night, we expect that mortality will decrease after the first day as smolt recover from stresses associated with transport to the stocking location. Although smolt are scheduled to be held for 5 days, they will be released early if any of the following occurs:

1) the daily mortality rate is ≥0.5%
2) the cumulative mortality rate is ≥1.0% from any given net pen
3) *Chaetoceros* spp. concentrations are unacceptable (see below)

Feeding

At NDFL, feeding will continue daily throughout the stocking period and continue for at least a week after the last stocking. The floats with covers will remain in place until feeding commences.

Smolt will be fed 1–2% of their biomass per day based on a feed chart provided by hatchery staff. The feed chart recommendations are based on the size of the smolt and water temperature. The number of Chinook salmon smolt and their average weight will be used to estimate the total biomass. A premeasured graduated container will be used to measure the feed.

The food will be dispersed by hand once daily and the amount of feed dispersed will be recorded at each feeding. The food will be slowly and evenly spread across the entire area to allow all fish access to the food and prevent wastage. If the smolt are not actively eating all of the food, then less food will be thrown to reduce the amount of waste.

Plankton sampling

Chaetoceros spp. sampling at NDFL will continue as part of the adaptive stocking plan. Concentrations will be estimated for every stocking day and for any day in which smolt remain held in the net pens. By sampling in this timely manner, we will be confident the *Chaetoceros* spp. concentrations at the time of stocking do not exceed recommended levels. In 2013, we compared our standard *Chaetoceros* spp. concentration estimates from the NDFL to other locations throughout Kachemak Bay and found that they were generally similar. We will also use the Kachemak Bay Research Reserve (KBRR) qualitative phytoplankton data to remain informed of *Chaetoceros* spp. abundance trends in Kachemak Bay.

To estimate *Chaetoceros* spp. concentration, 1 surface water sample will be collected from the floating net pens (outside of the nets). These samples will be collected during residual depth (<12 ft tide height). The primary water sample will be 1 L of unfiltered surface water at every sampling event. Approximately 0.25 L of surface water will be collected from all 4 corners of the floating net pens. Filtered water samples are necessary when *Chaetoceros* spp. concentrations are low (<30,000 cells/L). To determine whether filtering is needed, the unfiltered sample will be counted using a Sedgewick-Rafter counting slide (see methods below). If the *Chaetoceros* spp. count is less than 30 cells on an entire slide, then a filtered sample will be required for estimating the concentration. The smallest amount of water needed will be used for filtered samples to prevent filtration from crushing cells. Filtering will be used to concentrate a volume of surface water such that a detectable number of cells (>30) occurs on the counting slide.

The filtered water sample (up to 400 L) will be collected using either a bucket or a handheld electric bilge pump. Equal amounts of water will be collected at all 4 corners of the floating net pens. The water sample will be filtered through a 20-micron plankton net. After the water sample has been filtered through the net, the net will be rinsed into a 150 ml sample bottle attached to the bottom of the net to ensure all plankton from the sample are in the 150 ml bottle. The 150 ml sample bottle will be labeled with the date and taken to the Homer office for processing. Once the water samples arrive at the office, they will be stored in a cooler until they have been processed. Prior to subsampling, the water sample will be homogenized by slowly rotating it (not shaken) for 30 seconds. After the water sample has been homogenized, a pipette will be used to collect a subsample from the middle of the sampling bottle. The subsample will be placed on a counting slide and a cover slip will be gently placed over the subsample to keep it within the counting slide.

Several methods may be used to count the number of cells of *Chaetoceros* spp. Based on relative precision criteria for plankton sampling, roughly 100 cells of *Chaetoceros* spp. need to be counted for each slide (Karlson et al. 2010). If possible, every *Chaetoceros* spp. cell present on an entire gridded Sedgewick-Rafter counting slide will be counted. The Sedgewick-Rafter counting slide holds exactly 1.0 mL of water and has 20 rows with 40 grids each. If the anticipated number of cells is greater than 100 cells of *Chaetoceros* spp. then subsampling of the slide rows may occur during the counting process. Different methods of subsampling the rows of the Sedgwick-Rafter counting slide will be explored, but they will always involve counting all grids within a row. When concentrations of *Chaetoceros* spp. in the lagoon are considered at bloom levels (greater than about 1,000,000 cells/L for unfiltered samples), a Palmer counting slide will be used. The Palmer counting cell holds exactly 0.1 mL of water and is not gridded, so ideally the entire slide should be counted. If concentrations are too large to count every cell within the Palmer counting slide, then expansions based on area of field of view will be explored. Alternatively, expansions based on counting a small portion of a Sedgewick-Rafter counting slide may also be considered.

As time allows, replicate counts will be done for each water sample. Ideally, a minimum of 3 counts will be produced for each sample. The concentration of *Chaetoceros* spp. for each water sample will be calculated with appropriate expansions based on dilution, filtering, counted slide volume, or combinations of these. In 2012, 3 replicate counts were made every day from the same water sample. The average daily 95% relative precision was 20%, and it increased (less precise estimate) when concentrations were below bloom levels.

Composition of Chinook Salmon in the Sport Fishery Area

Prior to the first 3-day weekend fishery for wild and hatchery-reared Chinook salmon and prior to the 16 June opening for hatchery-reared Chinook salmon, a beach seine survey will be conducted in the lower 3.2 RKM of the Ninilchik River to assess the composition of the Chinook salmon run in the sport fishery area. The survey will start at Garrison Ridge Road Bridge and end just prior to the harbor (Figure 2). The beach seine will be deployed from shore or a small raft just upstream of where Chinook salmon are thought to be holding. Methods will be identical to the beach seine surveys conducted in 2007 (Booz and Kerkvliet 2011c), except that only 1 survey will occur. Hatchery-reared Chinook salmon are easily identified by the absence of the adipose fin. During the survey, the number of wild and hatchery-reared Chinook salmon will be recorded each time the beach seine is deployed. Based on the desired precision criteria for Objective 3, the minimum sample size will be 68 Chinook salmon. This sample size is conservative, given no finite population correction factor was used and a worst-case situation of 50% hatchery fish was assumed (Cochran 1977). Based on beach seine surveys conducted in 2007 and 2011–2017, this sample size is easily obtainable. In the 8 beach seine surveys conducted over these years, the number of Chinook salmon caught has ranged from a low of 65 (2016) to a high of 354 (2014).

DATA COLLECTION

Chinook salmon escapement data collected at the weir by video (Appendix B1) and livebox (Appendix B2) will be recorded onto datasheets and then entered in a field-specific Access database (e.g., 2018 Ninilchik Field Database.mdb; Appendices C1 and C2). Daily and cumulative fish counts and biological sample data will be automatically generated using queries and reports from this database (Appendix C2). All data will be proofed postseason before analysis begins.

Water temperature data from the HOBO Tidbit Temperature Logger will be downloaded by the weir technician once per shift. Hourly temperature data will be formatted and stored in the Ninilchik field database. The stage height data from National Weather Service, Alaska Pacific River Forecast Center (RFC) will be downloaded postseason for further analysis. All water data will be proofed and stored on the O: drive in the Homer office for further analysis postseason.

Data collected during Ovaplant injections and while holding the fish in raceways will be recorded on data sheets as illustrated in Appendix B3. Chinook salmon egg-take data will be collected on datasheets as illustrated in Appendix B4. These data will be entered in the "Ovaplant Table" within the Ninilchik field database, and stored postseason at the Homer office on the O: drive.

Dissolved oxygen (mg/L) and temperature (°C) measurements of the river and raceways will be recorded on data sheets as illustrated in Appendix B5.

Chinook salmon data collected during beach seine surveys will be recorded on a netting data sheet by sex, size (<508 mm or ≥508 mm TL), and wild or hatchery (Appendix B6). Copies of the beach seine composition data will be made at the Homer office, stored in the file cabinet, and entered into the appropriate report spreadsheet on the O: drive.

Heads collected from hatchery-reared Chinook salmon sacrificed for egg takes will be assigned an individually numbered CWT cinch strap and recorded on both the egg-take data form (Appendix B4) and on the CWT data entry form (Appendix D1). Copies of the CWT data entry forms will be made for reference and stored at the Homer office prior to sending the heads to the ADF&G Mark, Tag, and Age Laboratory in Juneau.

NDFL smolt stocking data will be recorded onto datasheets (Appendix B7) and then entered into Excel spreadsheets at the Homer office. Plankton data will be directly entered into an Excel spreadsheet. Water quality data will be downloaded into Excel spreadsheets at the KBRR laboratory.

A backup copy of all data files will be saved on a jump drive at the end of each day. Data on the jump drive will be taken to the Homer office as often as possible during the field season. Scale cards will be examined for completeness, accuracy, and scale placement. All data files and forms will be reviewed for completeness and accuracy by the biologist leading the fieldwork.

DATA REDUCTION

All data will be appended to tables within an Access database (*NinilchikRiver_master.mdb*) for final editing and will be stored on the local network O: drive in the Homer office (Appendix E1). All data will also be copied onto a DVD and archived in the Homer office. Additionally, all pertinent data files will be submitted to ADF&G Research and Technical Services (RTS) along with the final Fishery Data Series report. These data files will be archived in RTS publication archives and will be associated with the published report (MacClellan et al. 2012: page 20).

Inseason Reporting and Summaries

Field notes are an important means to communicate activities and conditions to crewmembers and supervisors. Furthermore, field notes can be extremely valuable postseason in evaluating data. The crew will write field notes in an Excel workbook saved to the Ninilchik field computer that will include the following: date, first and last name, and general weather and water conditions (Appendix F1). Notes must include pertinent information on unusual activities so that fish counts, holding numbers, egg-take results, or video counting and review at later dates can be understood in context. Examples of activities that should be noted in the field log include dates that video quality was poor due to lights out in the camera box, when those lights were replaced, if the upper or lower weir was compromised, when and how many Chinook salmon were captured in the holding area due to weir compromises, what their fate was, how these instances were added to data sheets and the field database, video software glitches, and how video settings were adjusted to troubleshoot. The field notes document will be e-mailed to project biologists during the season if needed and saved on the O: drive at the office at the end of the season for future reference when reconciling data or other questions postseason. Additionally, it will be possible for project biologists to access the field log via remote access if information is needed immediately.

DATA ANALYSIS

Primary Objective 1: Escapement

Annual escapement for each of the wild and hatchery-reared components of the Ninilchik River Chinook salmon run by size (Secondary Objective 5) will be calculated by summing the daily weir counts and subtracting all mortalities associated with processing fish through the weir, broodstock collection, and removal from the escapement.

Fate codes will be assigned to each fish record as follows:

1) passed upstream for escapement

2) held for egg takes

3) CWT removal

4) weir mortality

5) holding-area mortality

6) spawned in egg take

7) released upstream from the holding area for escapement

8) hatchery-reared escapement removal from the live box

9) hatchery-reared escapement removal from the holding area

10) passed downstream (video monitoring)

11) treated with Ovaplant

Daily weir counts are equal to the sum of fate codes 1 through 4 and code 8. Daily escapement removals are the sum of fate codes 3 through 6 and 8 through 9. Cumulative escapement is calculated as the sum of the daily weir counts minus the sum of the daily removals.

Although only wild Chinook salmon escapement can be used to achieve the SEG, hatchery-reared escapement will be calculated in the same fashion as the wild escapement to assess composition of the total escapement.

Primary Objective 2: Age, Sex, and Length Compositions

Prior to 2010, the age and sex compositions were estimated from the samples of wild and hatchery-reared Chinook salmon collected for length, sex, and scales (Primary Objective 2). These estimates were generated without regard to the "sex" information also collected in the census of the escapement (Secondary Objective 1). In some years, such as 2007, the sampling estimated more males than the census and biased age-sex estimates (Booz and Kerkvliet 2011b). The reason that males were over-selected when sampling is unknown. The selectivity could be a result of the method used to process fish in the live box, or because of differential behavior between males and females that influenced how they arrived at the weir, or the order in which they were processed in the live box.

To reduce bias associated with possible sex-selective sampling for wild and hatchery-reared fish, the age and sex composition estimates from the samples will be calculated by incorporating the known sex composition from the video and weir census.

Due to small run sizes from 2009 through 2014, all hatchery-reared Chinook salmon were sampled for age and length. In 2018, we anticipate an increase in run size due to a full complement of hatchery-reared age classes. Therefore, the hatchery-reared component of the Chinook salmon run, like the wild component, will be sampled, rather than measuring every fish.However, the age, sex, and length compositions will be calculated in the same fashion for both components of the Chinook salmon run using the known sex composition from the weir census, not the age and length sampling. Analysis for the wild component is described below.

For the wild component of the Chinook salmon run, the proportion by sex to the weir is known and will be calculated as

$$p_i = \frac{N_i}{N} \tag{2}$$

where

N_i = number of wild fish of sex class i in N (Secondary Objective 1),

N = number of wild fish counted at the weir (Primary Objective 1)

The proportion of wild fish of age j given sex i will be estimated as follows:

$$\hat{p}_{j|i} = \frac{x_{ij}}{n_i} \tag{3}$$

where

x_{ij} = number of wild fish of age class j in n_i,

n_i = number of fish of sex class i in wild fish sampled for age.

with variance estimated as

$$\mathrm{var}\left(\hat{p}_{j|i}\right) = \left[\frac{N_i - n_i}{N_i}\right]\left[\frac{\hat{p}_{j|i}\left(1-\hat{p}_{j|i}\right)}{n_i - 1}\right]. \tag{4}$$

Abundance of wild fish of age j given sex i will be estimated as follows:

$$\hat{N}_{ji} = \hat{p}_{j|i} N_i \tag{5}$$

with variance estimated as

$$\mathrm{var}\left(\hat{N}_{ji}\right) = N_i^2 \mathrm{var}\left(\hat{p}_{j|i}\right). \tag{6}$$

The proportion of wild fish in age class j and sex class i in the wild weir run will be estimated as follows:

$$\hat{p}_{ji} = \frac{\hat{N}_{ji}}{N} \tag{7}$$

with variance estimated as

$$\mathrm{var}\left(\hat{p}_{ji}\right) = \frac{1}{N^2} \mathrm{var}\left(\hat{N}_{ji}\right). \tag{8}$$

The abundance of wild fish in age class j in the run will be estimated by summing over sex i:

$$\hat{N}_j = \sum_{i=1}^{2} \hat{N}_{ji} \tag{9}$$

with variance estimated as

$$\mathrm{var}\left(\hat{N}_j\right) = \sum_{i=1}^{2} \mathrm{var}\left(\hat{N}_{ji}\right) \tag{10}$$

The proportion of wild fish in age class j in the run will be estimated as follows:

$$\hat{p}_j = \frac{\hat{N}_j}{N} \tag{12}$$

with variance estimated as

$$\mathrm{var}(\hat{p}_j) = \frac{\mathrm{var}(\hat{N}_j)}{N^2}. \tag{13}$$

Secondary Objective 4: Length at Age by Sex

The mean length at age *j* by sex *i* for wild fish will be estimated as follows:

$$\bar{l}_{ji} = \frac{\sum_{k=1}^{n_{ji}} l_{jik}}{n_{ji}} \tag{14}$$

where

l_{jik} = length of the *k*th wild fish sampled for length of age class *j* and sex *i*,

n_{ji} = number of wild fish of age class *j* and sex *i* sampled for length.

with variance estimated as

$$\mathrm{var}(\bar{l}_{ji}) = \left\{\frac{(\hat{N}_{ji} - n_{ji})}{\hat{N}_{ji}}\right\}\left\{\frac{\sum_{k=1}^{n_{ji}}\left[l_{jik} - \bar{l}_{ji}\right]^2}{n_{ji}(n_{ji} - 1)}\right\} \tag{15}$$

Estimates of sex and age composition and mean length by sex and age for hatchery-reared fish will be made using Equations (2–15) with appropriate substitutions.

Secondary Objective 9: Within-Reader Variability of Scale Age Estimates

The within-reader variability of scale age estimates will be calculated using a coefficient of variation (CV) expressed as the ratio of the standard deviation over the mean age (Campana 2001):

$$CV_j = 100\% x \frac{\sqrt{\sum_{i=1}^{R} \frac{(X_{ij} - X_j)^2}{R-1}}}{X_j} \tag{16}$$

where

X_{ij} = the *i*th age estimate of the *j*th fish,

X_j = the mean age estimate of the *j*th fish, and

R = the number of times each fish is aged.

For each sex, age, and wild or hatchery-reared group, the CV_j will be averaged across all fish (*j*) in the group to produce a mean CV.

The accuracy of age estimates can only be assessed for hatchery-reared fish that have biological data and a detectable CWT. The age estimates from these fish will be compared to the determined age from CWT data and expressed as a percentage of agreement.

Primary Objective 3: Composition of Chinook Salmon in Sport Fishery Area

The percentage of wild Chinook salmon in the river below the weir at the time of sampling will be estimated as a binomial proportion (Cochran 1977):

$$\hat{p}_w = \frac{n_w}{n} \tag{17}$$

where n_w is the number of wild Chinook salmon observed in n, the total number of Chinook salmon sampled. The variance will be estimated as follows:

$$\mathrm{var}(\hat{p}_w) = \frac{\hat{p}_w(1-\hat{p}_w)}{n-1}. \tag{18}$$

Secondary Objective 10: Water Temperature and Stage Height

Pearson's correlation coefficient (r) will be used to test the null hypothesis $r = 0$ for correlations between daily Chinook salmon (wild and hatchery-reared) weir counts and water temperature or stage height throughout the entire run through the weir. The null hypothesis will also be tested for temperature and stage height lagged over time.

Secondary Objective 11: Plankton Concentration

Plankton concentration (k) for a given day in NDFL in cells/L will be estimated daily as follows:

$$\hat{k} = \frac{\sum_{i=1}^{D} c_i \rho}{D} \tag{19}$$

where

c_i = count of *Chaetoceros* spp. from counting cell for ith daily sample (D total samples per day, up to 3).

ρ = Expansion factor accounting for counting slide subsampling and volume-based adjustments (e.g., slide volume, filtering)

Variance of $\hat{k}$ will be estimated as

$$\mathrm{var}(\hat{k}) = \rho^2 \frac{s^2}{D} \tag{20}$$

where s^2 is the sample variance of the c_i. It is noted that the variance in Equation 20 pertains to within-sample variability and does not reflect variability across the lagoon, which is assumed relatively small, based on spatial sampling results from 2012.

SCHEDULE AND DELIVERABLES

Crew schedules from late June through August are outlined in Appendix F2.

Dates	Activity
April 1	Begin arrangements for saltwater smolt releases
April 15–May 18	Begin equipment preparation for saltwater smolt releases
May 19–June 15	Fresh and saltwater smolt releases
May 1–May 16	Ninilchik weir preparation and install weir
May 16–June 29	Ninilchik video weir operation
June 30–July 31	Ninilchik live-box weir operation
June 13–June 28	Beach seine Ninilchik River
July 1–July 31	Ninilchik River egg takes
August 1–August 8	Ninilchik video weir operation
August 9–August 15	Break down and store Ninilchik weir and camp materials
September 15–October 15	Age scales and preparation of FDS Report
October 15–February 15	FDS Reporting
October 1–May 15	Correction of Federal Aid report and operational planning

Results of this study will be reported as an ADF&G, Sport Fish Division, Data Series report.

RESPONSIBILITIES

Carol Kerkvliet, Fishery Biologist III, Project Supervisor

Duties: Oversees project by supervising operational planning, analysis, and reporting. Tracks implementation of operational plan and reporting and maintains daily contact with the field project leader. Prepares and tracks budget, hiring, and supervising of crewmembers. Maintains contact with the field crew, provides assistance and direction when needed, oversees daily reporting and summarization of data.

Holly Smith, Fishery Biologist I, Field Project Leader

Duties: Under the supervision of the Fishery Biologists II and III, leads field work and supports weir crew with daily weir operations including ASL sampling, hatchery-reared fish removal, and holding Chinook salmon for egg takes as outlined in the operational plan. Drafts operational plan and annual report with oversight from project leaders. Routinely visits with the crew to observe activities, provide assistance, and discuss weir and stocking operation and sampling. Responsible for summarizing season data, aging scales, and inseason escapement counts. Trains weir technicians in processing video files to produce daily fish counts by species. Trains technicians in producing daily and seasonal Chinook salmon weir counts using datasheets and Access field database. Assesses maturity and conducts egg takes.

Michael Booz, Fishery Biologist II, Project Leader

Duties: Co-authors operational plan and annual report. Provides necessary level of training, assistance and direction to the crew when needed. Completes routine administrative duties such as reviewing time sheets and approving leave. Responsible for leading crew with the installation, maintenance and dismantling of the weir and stocking equipment. Coordinates stocking with hatchery personnel and barge operators and egg takes with hatchery staff and volunteers. Processes required land leases. Responsible for annual Federal reporting requirements. Conduct egg takes.

Vacant, Fishery Technician III

Duties: Responsible for supporting weir crew with daily weir operations including ASL sampling, hatchery-reared fish removal, and holding Chinook salmon for egg takes as outlined in operational plan. Maintains daily contact with the field crew. Routinely visits with the crew to observe activities, provide assistance, and discuss weir and stocking operation and sampling. Responsible for installation and maintenance of raceway equipment. Leads weir technicians in processing video files to produce daily fish counts by species. Maintains equipment logs and ensures maintenance schedules. Leads technicians in producing daily and seasonal Chinook salmon weir counts using datasheets and Access field database. Assesses maturity and conducts egg takes.

Timothy Blackmon, Fishery Technician III

Duties: Leads the installation, maintenance, and dismantling of floating net pens for stocking, and leads the transporting, feeding and release of smolt. Assesses daily mortalities of held smolt, collects and counts plankton samples, and communicates status of stocking with project leader, field project leader, and hatchery staff. Assists with the installation and dismantling of the fish weir and holding area and egg takes.

Ben Dubbe, Fishery Technician II

Duties: Responsible for supporting weir crew with daily weir operations including ASL sampling, hatchery-reared fish removal, and holding Chinook salmon for egg takes as outlined in operational plan. Install, maintain, operate, and dismantle floating net pens for stocking. Transport, feed, release, and assess mortality of smolt. Install, maintain, and dismantle fish weir. Counts and summarizes daily and seasonal Chinook salmon weir counts. Assesses maturity and conducts egg takes.

Vacant, Fishery Technician II

Duties: Installs, maintains, and dismantles fish weir. Responsible for daily operation of the weir. Collects ASL samples as outlined in operational plan. Counts and summarizes daily and seasonal Chinook salmon weir counts. Assess maturity and conduct egg takes.

Vacant, Fishery Technician II

Duties: Installs, maintains and dismantles fish weir. Responsible for daily operation of the weir. Collects ASL samples as outlined in operational plan. Counts and summarizes daily and seasonal Chinook salmon weir counts. Assess maturity and conduct egg takes.

David Evans, Biometrician III

Duties: Provides technical assistance with statistical procedures and sample designs. Reviews and recommends procedures for data analysis. Edits Technical Data Report.

BUDGET SUMMARY

Project FY 2019

Ninilchik Chinook salmon stock assessment

Line item	Category	Budget ($K)
100	Personal Services	20.0
200	Travel	0.0
300	Contractual	5.6
400	Commodities	3.6
500	Equipment	0
Total		29.2

Egg takes and stocking

Line item	Category	Budget ($K)
100	Personal Services	14.4
200	Travel	0.0
300	Contractual	8.0
400	Commodities	24.9
500	Equipment	0
Total		47.3

Budget Manager: Carol Kerkvliet

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APPENDIX A: CHINOOK SALMON PROCESSING AND SAMPLING PROCEDURES

Appendix A1.–Flow chart for Chinook processing at the Ninilchik River broodstock weir, 2018.

For Every Chinook Salmon

Caudal Clip

Present	Absent
↓	↓
Record as recapture Pass upstream	Clip upper lobe

Adipose Fin

Present	Absent
Record as Wild	Record as Hatchery

Sex

↓

Assess every fish based on external charactristics
Record as Male or Female

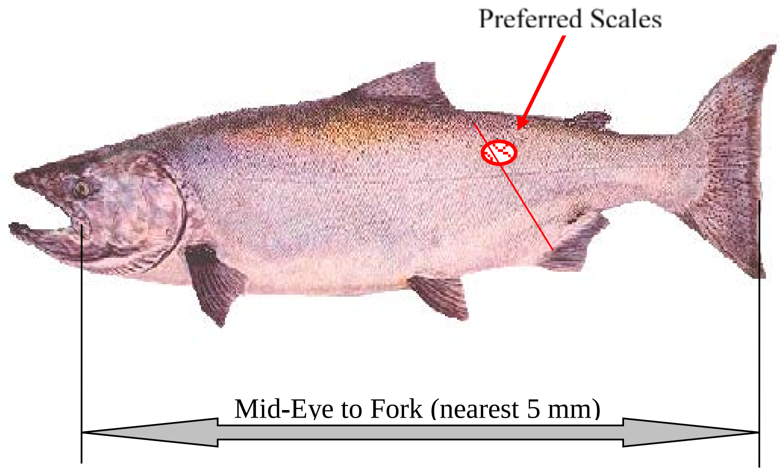
Jack

≤508 TL	>508TL
↓	↓
Record as Yes	Record as No

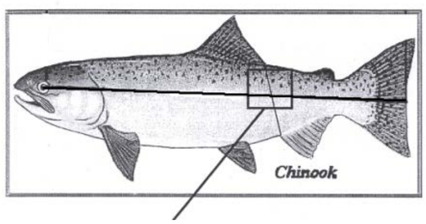
Subsampling Days **Starts at the opening of the weir and occurs in order as they arrive to the weir**			**NonSubsampling Days**		
Wild	**Hatchery**		**Wild**	**Hatchery**	
↓	↓		↓		
collect 3 scales & Measure MEFT with sampling rate of 0.20	collect 3 scales & Measure MEFT with sampling rate of 0.27			≤508 TL	>508TL
	≤508 TL	>508TL			
↓	↓	↓		↓	↓
Hold or release as directed	*Remove from escapement*	*Place in holding area*	*Hold or release as directed*	*Remove from escapement*	*Place in holding area*

Minimize handling stress as follows:

1) Prevent a large number of fish from entering the livebox at one time.
2) Do not remove fish from water unless necessary.
3) Use net and sampling cradle to control fish.
4) Process each fish as quickly as possible.
5) Provide recovery area for fish released upstream.

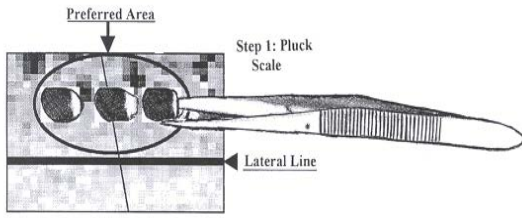


Preferred scales are located on the left side of the fish, two rows above the lateral line along a diagonal line from back (posterior) of the dorsal fin to the front (anterior) of the anal fin.



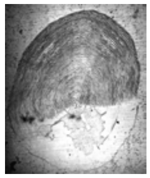
Pull the "preferred scale" from the fish using forceps.

Pliers may be necessary to remove scales if the fish has been in freshwater for an extended period.



A good scale has a well-rounded shape.

Hold scale up to light and examine for overall size, shape, regeneration, deformities, etc.



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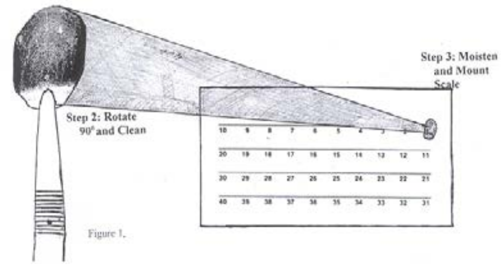
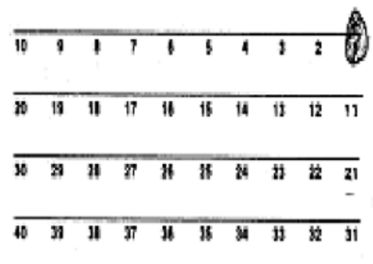


Remove all slime, grit, and skin from scale by rubbing between thumb and forefinger. Place scales in the pre-numbered container. One set of three scales per fish per collection.

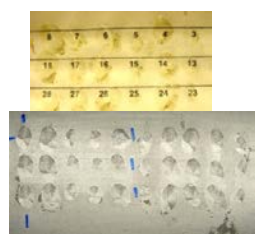
At the end of the day, mount the scales from each collection onto the gum cards. When mounting, be careful not to invert the scale and try to mount the insertion point up.



Gum cards are numbered from right to left. One fish per column and 10 fish per gum card.

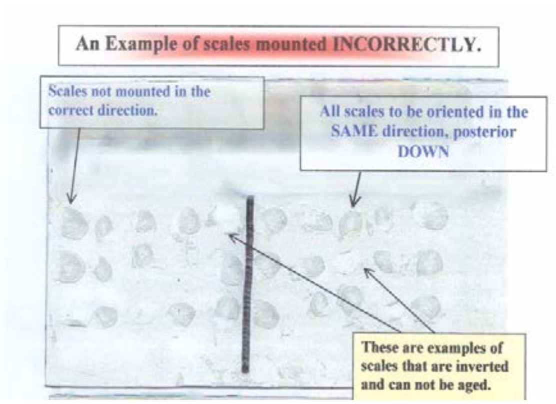
After mounting every collection of scales for the day, attach a piece of wax paper over the gum card with a paper clip. Store the gum cards in a Ziploc bag and send them to the Homer office as soon as possible.

At the Homer office, the gum cards will be pressed onto an acetate.

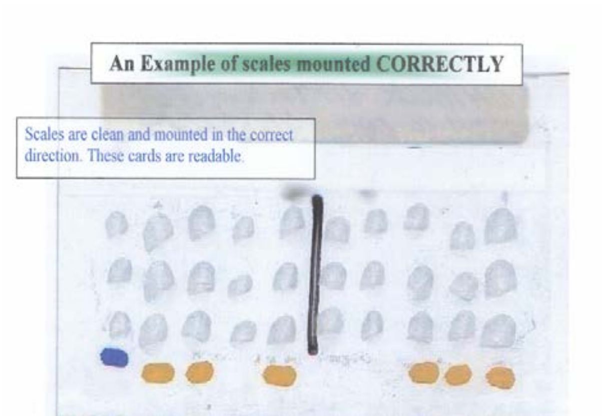


-continued-

Incorrect scale mounting



Correct scale mounting



Common problems encountered with inexperienced scale collectors are torn edges, inadequate scale cleaning, selecting regenerated or distorted scales, inverted scale mounting, and dirty gum cards. Common data recording errors include recording the wrong origin (wild or hatchery), recording the wrong scale number for the sample, a mismatch between number of scale samples and number recorded in data, and more than 1 fish with the same collection number. Experienced staff must take extra measures to ensure that less experienced staff become fully proficient at sampling before the first sampling event. Before the first sampling event, experienced staff will take 1 fish and slowly walk through the sampling routine with less experienced crew. This routine should specifically demonstrate to the following:

1) Locate the lateral line and preferred scale sampling area.
2) Identify irregular scale patterns that are the result of regenerated scales.
3) Remove the scales in a manner that reduces torn edges.
4) Properly clean and mount scale samples.
5) Identify inversely mounted scales.

Minimize the handling of gum cards and keep them as dry as possible. Wet gum cards should be dried out slowly. Excessive heat when drying may cause the scale to become unglued from the gum card. After the gum cards are dry they should be stored with wax paper between each gum card. Check the numbering between the Access database and the gum card.

A final step to improve quality is to identify sampling problems promptly so that corrections can be implemented in season. To achieve this, gum cards should be sent to the Homer office as quickly and as often as possible throughout the season. The person actually collecting the scales needs to be identified on each gum card so feedback can be effectively directed to the source.

Reader Verification

Readers will review a test set of 100 scale samples from both wild and hatchery-reared Chinook salmon collected from 1999 through 2007 at the weir. At least 50 scale samples within the test set will be of a known age and the test set will include samples of all ages. Readers' test set ages will be compared to previous age estimates and known ages. Ages that do not match will be reviewed and re-read. Once the reader ages are resolved, then the reader will begin with the collected samples from this season.

Scale Interpretation and Criteria

To estimate scale age, at least 1 scale per sample must have all of the following characteristics:

1) A clean focus.
2) Little or no regeneration in the freshwater growth area.
3) Minimal tearing on the edge.
4) Clearly identified annuli through winter growth periods and crossing over of rings.

If none of the scales in a sample contains all of these characteristics, then the age will be recorded as "NR" (not readable). If differing scale age estimates are obtained within a scale sample, the age for that fish will be recorded as "NR."

APPENDIX B: WIER DATA ENTRY FORMS

Appendix B1.–Ninilchik video data entry form, 2018.

2018 Video Weir Data Entry Form

Location: Crew: Date: Ext. hard drive:

Hour	Wild				Hatchery			
	Large Males	Females	Jacks[1]	LM/F	Large Males	Females	Jacks[1]	LM/F
0000								
0100								
0200								
0300								
0400								
0500								
0600								
0700								
0800								
0900								
1000								
1100								
1200								
1300								
1400								
1500								
1600								
1700								
1800								
1900								
2000								
2100								
2200								
2300								
Total								

3AM reviewed? __________ **Wild Total:** **Hatchey Total:**

If full record needed, note which hours: ______________________ *and when completed:* _________ *by:* ____________

Daily Subsample Calculation

Chinook counted since sampling on previous day ______ X

sampling rate ______ = ______ (# Chinook to be sampled today)

walked/ fish tight?

Chinook Total:

Water Data	AM	PM
Depth (")		

Video backed up to ext. hard drive?

Data Proofing Steps	**Initial Check**		**Final Check**	
	Date	Staff	Date	Staff
Datasheet proofed:				
Summary proofed:				
Access proofed:				

[1] Jack: <508 mm TL

Appendix B2.–Ninilchik weir data entry form, 2018.

Ninilchik River Weir Fish Data Entry Form

Date: Crew: Page: of

Chinook salmon Data

#	Hour	Adfin (W/H)	# of fish	Sex (M/F/U)	Jack (Y/N)	Fate *	Caudal (U/L/N)	Recap (Y/N)	Sampling data: Length MEFT (mm)	Scales: Card	Scales: Col	Floy tag or CWT	Comments
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													

Page Totals:	**WILD**	Male	Jack	Female	Total Wild	**Hatchery**	Male	Jack	Female	Total H	**Hold Mort Summary**		
	Up					Up						M	F
	Held					Held					W		
	pg. total					Culled					H		
						pg total							

Other Species Tally

Pink salmon	dolly varden	coho salmon	chum salmon	sockeye salmon	steelhead

* 1=up; 2=held; 3= CWT mort; 4=weir mort; 5=holding mort; 6=eggtake removal; 7=holding release; 8=livebox removal; 9= hatchery male holding pen removal

Jack (Y=yes(<508mm total length) N=no(>508mm total length); Caudal (U=upper, L=lower, N=none); Recap (Y=yes(caudal fin already clipped), N=No(no previous clip on caudal)

Appendix B3.–Ovaplant reporting data entry form, 2018

Raceway 1

		Wild		Hatchery	
	Date	Male	Female	Male	Female
Injection					
Daily Hold Morts					
Day 1					
Day 2					
Day 3					
Day 4					
Day 5					
Day 6					
Day 7					
Total hold morts					
Spawned					
Spawned but green					
Leftovers					
Total					

Raceway 2

		Wild		Hatchery	
	Date	Male	Female	Male	Female
Injection					
Daily Hold Morts					
Day 1					
Day 2					
Day 3					
Day 4					
Day 5					
Day 6					
Day 7					
Total hold morts					
Spawned					
Spawned but green					
Leftovers					
Total					

Raceway 3

		Wild		Hatchery	
	Date	Male	Female	Male	Female
Injection					
Daily Hold Morts					
Day 1					
Day 2					
Day 3					
Day 4					
Day 5					
Day 6					
Day 7					
Total hold morts					
Spawned					
Spawned but green					
Leftovers					
Total					

Raceway 4

		Wild		Hatchery	
	Date	Male	Female	Male	Female
Injection					
Daily Hold Morts					
Day 1					
Day 2					
Day 3					
Day 4					
Day 5					
Day 6					
Day 7					
Total hold morts					
Spawned					
Spawned but green					
Leftovers					
Total					

Appendix B4.–Ninilchik egg-take data sheet, 2018.

Ninilchik River Weir Eggtake Data Entry Form

Date: Crew: Page: of

Chinook salmon Data

#	Fish #	Adfin (W/H)	# of fish	Sex (M/F)	Jack (Y/N)	Fate *	Caudal (U/L/N)	sampling data MEF Length	BKD	Genetic vial	Ovaplant Floy Tag	Comments
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												

Page Totals:

WILD	Male	Jack	Female	Total Wild
Egg. Mort (6)				
Egg. Release (7)				
Sacrificed, but green (5)				

Hatchery	Male	Jack	Female	Total H
Egg. Mort (6)				
Egg. Release (7)				
Sacrificed but green (5)				

* 1=up; 2=held; 3= CWT mort; 4=weir mort; 5=holding mort; 6=eggtake removal; 7=holding release; 8=livebox removal; 9= hatchery male holding pen removal

Appendix B5.–Raceway and river dissolved oxygen and temperature data entry form, 2018.

Raceway Data	Date:

Raceway 1			
# of fish	start:______	end:______	
Time	DO (mg/L)	Temp(C)	O_2 (LPM)
800			
1000			
1200			
1400			
1600			
1800			
2000			
2200			

Raceway 2			
# of fish	start:______	end:______	
Time	DO (mg/L)	Temp(C)	O_2 (LPM)
800			
1000			
1200			
1400			
1600			
1800			
2000			
2200			

Raceway 3			
# of fish	start:______	end:______	
Time	DO (mg/L)	Temp(C)	O_2 (LPM)
800			
1000			
1200			
1400			
1600			
1800			
2000			
2200			

Raceway 4			
# of fish	start:______	end:______	
Time	DO (mg/L)	Temp(C)	O_2 (LPM)
800			
1000			
1200			
1400			
1600			
1800			
2000			
2200			

River			
Time	DO (mg/L)	Temp(C)	O_2 (LPM)
800			
1000			
1200			
1400			
1600			
1800			
2000			
2200			

Oxygen Tank:	
Start:___________	End:___________

Comments:____________________________

Appendix B6.–Beach sein survey data entry form, 2018.

Netting Data Form		**Date:**
Location:	**Crew:**	**Page #** ______of______

#	Set #	Sampler	W/H	M/F/J	MEF Length	Color	Scale		CWT #	Other Species
							Box	Collection		
1										Steelhead
2										**M**
3										
4										
5										
6										**F**
7										
8										
9										
10										
11										Dolly Varden
12										
13										
14										
15										
16										
17										
18										Pink Salmon
19										
20										
21										
22										
23										
24										
25										Other
26										
27										
28										
29										
30										

Appendix B7.–Stocking data entry form, 2018.

Stocking Data Entry Form

Location ________________ Stocking Date ____________________________ Page________ of________

Species Number of smolt Avg. Weight

Pen Number				
Number of smolt________________	Release Date _____________		Max food per feeding______________	
0.5% Est.	1.0% Est.			
		Amount of Food		
Day	Morts	Morning	Evening	Comments
1				
2				
3				
4				
5				

Pen Number				
Number of smolt________________	Release Date _____________		Max food per feeding______________	
0.5% Est.	1.0% Est.			
		Amount of Food		
Day	Morts	Morning	Evening	Comments
1				
2				
3				
4				
5				

Pen Number				
Number of smolt________________	Release Date _____________		Max food per feeding______________	
0.5% Est.	1.0% Est.			
		Amount of Food		
Day	Morts	Morning	Evening	Comments
1				
2				
3				
4				
5				

Pen Number				
Number of smolt________________	Release Date _____________		Max food per feeding______________	
0.5% Est.	1.0% Est.			
		Amount of Food		
Day	Morts	Morning	Evening	Comments
1				
2				
3				
4				
5				

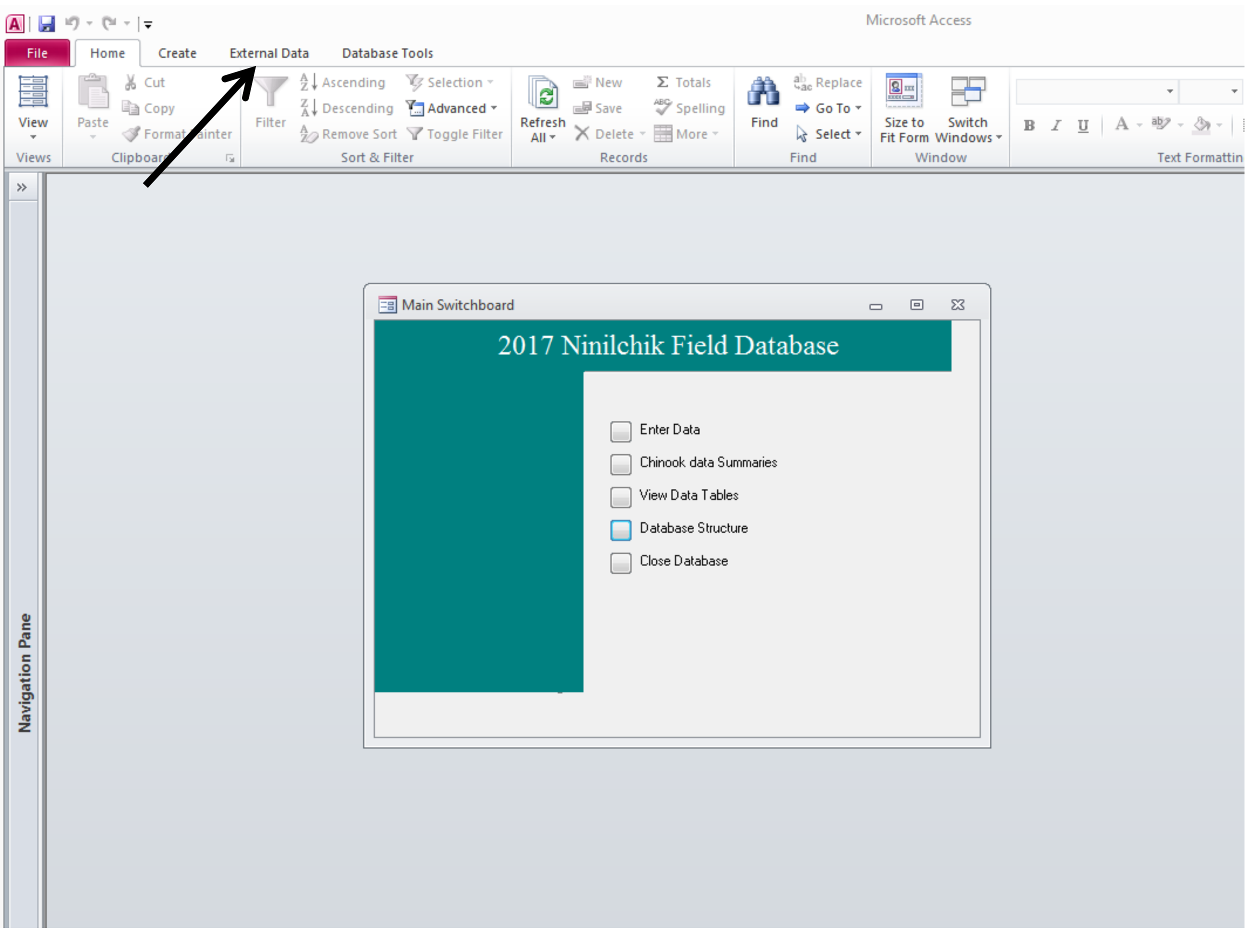
APPENDIX C: FIELD DATABASE

Appendix C1.–Ninilchik field database fish table and data entry form fields.

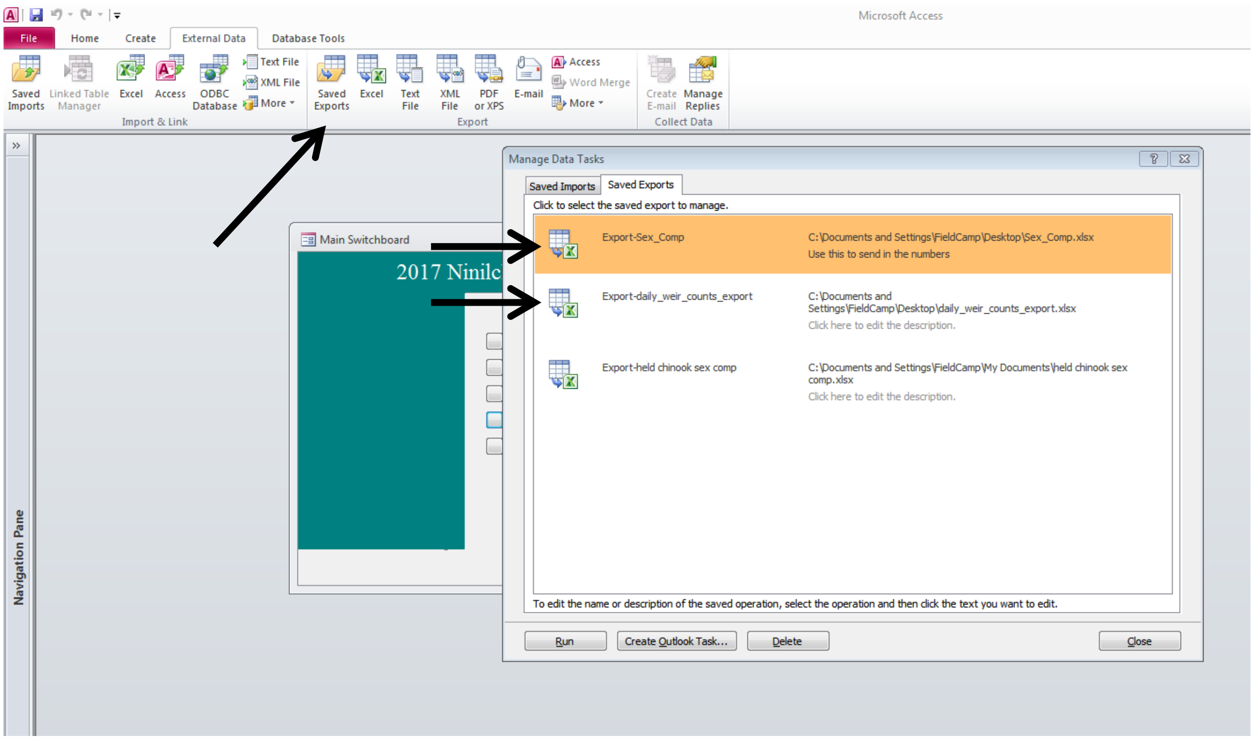
Fish Table			
Field Name	**Column #**	**Data Type**	**Description**
ID	F1	AutoNumber	Primary Key
Date	F16	Number	Date
Hour	F17	Number	Hour
Species	F2	Number	410=Chinook salmon 420=Sockeye salmon 430=Coho salmon 440=Pink salmon 450=Chum salmon 530=Dolly Varden 540=Steelhead trout 541=Rainbow trout 600=Pacific lamprey 900=Unknown or other (if “900” is entered, an explanation should be included in the comments.
# Fish	F3	Number	Number of fish
Adfin	F4	Number	0=Wild (adipose fin present) 1=Hatchery (adipose fin absent) 3=Unknown
Jack	F5	Number	0=Not a jack -1=Jack
Sex	F6	Number	1=Male 2=Female 0=Unknown
Fate	F8	Number	1=Up 2=Held 3=CWT 4=Weir Mort 5=Hold Mort 6=Eggtake Removal (mort) 7=Holding Release 8=Livebox Removal 9=Hatchery Male Holding Pen Removal 10=down 11=Ovaplant injection
MEFT	F7	Number	Mid-eye to fork length in mm
Card	F9	Number	Scale card number
Column	F10	Number	Column on scale card
Recap	F11	Number	0=New 1=Recap
Caudal	F12	Number	1=Upper 2=Lower 3=None
Comments	F14	Memo	Comments
Genetic Vial	F18	Number	Genetic vial sample #
Time	F15	Number	Time (used with Allegro)
CWT	F13	Number	CWT number
HID	F1	Number	HID (used with Allegro)

Appendix C2.–Access-generated daily weir count exports.

There are 2 queries that will commonly be exported from the Access Ninilchik field database. Both can be examined in Excel by opening the Access database and selecting the External Data tab at the top.



Then select the Saved Exports option in the Exports section. This will open a Manage Data Tasks dialog box where you can select which query you'd like to send to an Excel file.



The daily_weir_counts_export query will produce the daily weir count for wild and hatchery Chinook salmon by number passed upstream, number held, and total.

daily_weir_counts_export

Date	Wild upstream	Wild held	Wild Weir Count	Hatchery up	Hatchery held	Hatchery jack culled	Hatchery Weir Count
5/10/2017	0	0	0	0	0	0	0
5/15/2017	0	0	0	0	0	0	0
5/16/2017	0	0	0	0	0	0	0
5/17/2017	0	0	0	0	0	0	0
5/18/2017	0	0	0	0	0	0	0
5/19/2017	0	0	0	0	0	0	0
5/20/2017	0	0	0	0	0	0	0
5/21/2017	0	0	0	0	0	0	0
5/22/2017	0	0	0	0	0	0	0
5/23/2017	0	0	0	0	0	0	0
5/24/2017	0	0	0	0	0	0	0
5/25/2017	0	0	0	0	0	0	0
5/26/2017	0	0	0	0	0	0	0
5/27/2017	0	0	0	0	0	0	0
5/28/2017	0	0	0	0	0	0	0
5/29/2017	0	0	0	0	0	0	0
5/30/2017	0	0	0	0	0	0	0

-continued-

The Sex_comp query will produce the number of wild and hatchery by males, females, and jacks that are counted at the weir each day. This query sums the fish with the fate code (F8) up (1), held (2), and livebox removal (8).

Sex_Comp

Date	W females	W large males	W jacks	total wild	H females	H large males	H jacks	total hatchery
5/15/2017	0	0	0	0	0	0	0	0
5/16/2017	0	0	0	0	0	0	0	0
5/17/2017	0	0	0	0	0	0	0	0
5/18/2017	0	0	0	0	0	0		
5/19/2017	0		0			0	0	
5/20/2017	0	0			0	0	0	0
5/21/2017		0	0		0	0	0	0
5/22/2017	0	0			0	0	0	0
5/23/2017		0	0		0	0	0	0
5/24/2017	0	0	0	0	0	0	0	0
5/25/2017	0	0	0	0	0	0	0	0
5/26/2017	0	0	0	0	0	0	0	0
5/27/2017	0	0	0	0	0	0		
5/28/2017	0		0			0	0	
5/29/2017		0			0	0	0	0
5/30/2017	0	0	0	0	0	0	0	0
5/31/2017		0			0	0	0	0
6/1/2017	0	0	0	0	0	0	0	0
6/2/2017	0	0	0	0	0	0	0	0
6/3/2017	0	0	0	0	0	0	0	0
6/4/2017	0	0	0	0	0	0	0	0

APPENDIX D: CODED WIRE TAG SAMPLING FORMS

Appendix D1.–Coded wire tag data entry form for Nininlchik River.

Alaska Department of Fish and Game

Coded Wire Tag Sampling Form

Rack Return and Escapement Survey
South Central, Westward and AYK Regions

Page info for this Sample Number only! See Instructions → PAGE ___ OF PAGES ___

SAMPLE NUMBER: 1 8 D E 2 0 0 X

SOURCE: (circle one) rack return **escapement survey**

SURVEY SITE: Ninilchik River Weir

SAMPLE TYPE: **random** select

SAMPLER: ______

DATE SAMPLED: __ __ - __ __ - 1 __

SAMPLING INFORMATION

This Box to be completed for RANDOM Samples Only

SPECIES (CODE)	TOTAL # FISH CHECKED FOR AD-CLIPS	# AD-CLIPS SEEN	WERE ALL CHECKED?
(410)CHIN			y n
(411)JACK CHINOOK-ONLY			y n
(420)SOCK			y n
(430)COHO			y n
(440)PINK			y n
(450)CHUM			y n
(540)STHD			y n

COMMENTS

AREA INFORMATION (DISTRICT - SUBDISTRICT)

			OTHER DISTRICTS
231-	245-	331-	
241-	246-	334-	
244-	247-		

NAME of PLACE SURVEYED: (HATCHERY OR STREAM) ______

WATER TYPE: saltwater **freshwater**

ANADROMOUS STREAM# (FRESHWATER-ONLY) 244-20-10090-____-____-____-____-____-____-____

HEAD RECOVERY INFORMATION

✓	HEAD NUMBER	SPECIES CODE	LENGTH (mid-eye to fork in mm)	CLIP	SEX

T:\FORMS\2011\VISIO\RACKCWA2011.VSD3/24/2011 01:40

Appendix D2.–Coded wire tag shipment form.

ALASKA DEPARTMENT OF FISH AND GAME

SHIPMENT SUMMARY FORM
CODED WIRE TAG HEADS

(PLEASE INCLUDE COMPLETED FORM WITH CWT SHIPMENT)

SOURCE: COMMERCIAL PNP SPORT PERS. USE SUBSISTENCE RACK ESCAPEMENT JUVENILE
(CIRCLE ALL INCLUDED)

SURVEY SITE (S):______________________ BEGINNING SAMPLE # ______________

HEADS RECOVERED FROM STATISTICAL WEEK # ____________ ENDING SAMPLE # ______________

DATES RECOVERED: _____ / _____ - _____ / _____ / _____
MONTH DAY MONTH DAY YEAR

1 [ ] + 2 [ ] − 3 [ ]

1: # OF HEADS LISTED ON SAMPLING FORMS

2: # OF HEADS SHIPPED WITHOUT DATA (SEE "A" BELOW)

3: # OF HEADS NOT SHIPPED (SEE "B" BELOW)

= 4 [ ]

4: ACTUAL # OF HEADS COUNTED BOXED FOR SHIPMENT

A
HEADS SHIPPED WITHOUT DATA
(IF SAMPLING FORM LOST, GENERATE NEW ONE)

CWT HEAD NUMBER* *(SIX DIGITS)						DATA ALREADY SENT?	OTHER, EXPLAIN BELOW

B
HEADS NOT SHIPPED

CWT HEAD NUMBER* *(SIX DIGITS)						HEAD WITH PROCESSOR	HEAD LOST	OTHER, EXPLAIN BELOW

COMMENTS: (USE BACK OF FORM IF NECESSARY)

DATE SHIPPED:______________ FORM COMPLETED BY: ______________________

T:\FORMS\2005\VISIO\SSUMMARY2005.VSD 05/12/05 03:16

APPENDIX E: IMPORTING TO THE MASTER DATABASE POSTSEASON

Export the data in the *Fish table* in the Ninilchik field database to an Excel spreadsheet. This table contains only Chinook salmon data. Add filters to all the columns so you can proof the data. Proof for daily weir counts by wild and hatchery, sex, jack, number of fish, and fate. Proof total wild and hatchery weir counts and SEG. Be sure to proof all egg-take data and numbers as well. Check that all fish with a scale card number also have a column number, etc.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	FishNo	Date	Release_Tim	Species	No	AdFin	Fate	Sex	Jack	MEF	Card	Col	Recap	Mark
2947		7/3/2014	8:00	410	1	0	1	1	0	0	0	0	0	
2948		7/3/2014	8:00	410	1	0	1	2	0	0	0	0	0	
2949		7/3/2014	8:00	410	1	0	1	2	0	0	0	0	0	
2950		7/3/2014	8:00	410	1	0	1	1	0	0	0	0	0	
2951		7/3/2014	8:00	410	1	0	1	2	0	0	0	0	0	
2952		7/3/2014	8:00	410	1	0	1	1	0	0	0	0	0	
2953		7/3/2014	8:00	410	1	0	1	1	0	0	0	0	0	
2954		7/3/2014	8:00	410	1	0	1	1	0	0	0	0	0	
2955		7/3/2014	8:00	410	1	0	1	1	0	0	0	0	0	
2956		7/3/2014	8:00	410	1	0	1	1	0	0	0	0	0	
2958		7/3/2014	9:00	410	1	0	1	1	-1	0	0	0	0	
2959		7/3/2014	9:00	410	1	0	1	1	0	0	0	0	0	
2962		7/3/2014	14:00	410	1	0	1	1	0	0	0	0	0	
2963		7/3/2014	14:00	410	1	0	1	1	0	0	0	0	0	
2964		7/3/2014	14:00	410	1	0	1	1	0	0	0	0	0	
2965		7/3/2014	14:00	410	1	0	1	1	0	0	0	0	0	
2966		7/3/2014	14:00	410	1	0	1	1	0	0	0	0	0	
2968		7/3/2014	19:00	410	1	0	1	1	0	0	0	0	0	
2969		7/3/2014	19:00	410	1	0	1	2	0	0	0	0	0	
2970		7/3/2014	19:00	410	1	0	1	1	0	0	0	0	0	
2971		7/3/2014	19:00	410	1	0	1	2	0	0	0	0	0	
2972		7/3/2014	19:00	410	1	0	1	1	-1	0	0	0	0	
2973		7/3/2014	19:00	410	1	0	1	1	0	0	0	0	0	
2974		7/3/2014	19:00	410	1	0	1	1	0	0	0	0	0	
2976		7/3/2014	20:00	410	1	0	1	1	0	0	0	0	0	
2977		7/3/2014	20:00	410	1	0	1	1	0	0	0	0	0	
2978		7/3/2014	20:00	410	1	0	1	1	0	0	0	0	0	
2979		7/3/2014	20:00	410	1	0	1	1	0	0	0	0	0	
2980		7/3/2014	20:00	410	1	0	1	1	0	0	0	0	0	
2981		7/3/2014	20:00	410	1	0	1	1	0	0	0	0	0	
2982		7/3/2014	20:00	410	1	0	1	1	0	0	0	0	0	

In the Excel workbook, order and name the columns so they exactly match the fields in the *FishDataTbl* in the master database. Make sure all data types match (for example, the jack column should be numbers, not a "Y/N"). Add all the columns in *FishDataTbl* to the Excel spreadsheet and add data where appropriate. For example, add 2018 to the year column. If there are scale ages available, add those and the ager to the appropriate columns.

All fish with fate code 7 "holding release" do not need to be entered into the master database. Fate code 7 is only used to keep track of the holding area summary in season, and is not needed postseason because that fish was also entered under fate code 2 "held." Select all fish with fate code 7 and delete them from the Excel spreadsheet.

-continued-

Export the *non-target_species table* from the Ninilchik Field database to an Excel spreadsheet. This table contains all of the data from fish species other than Chinook salmon. To incorporate the *non-target_species* data into the same Excel spreadsheet as the Chinook salmon data from the *Fish table*, create an entry for each date and species present. It should look like the following.

Date	Hour	Species	No
7/3/2014		530	6
7/4/2014		530	6
7/5/2014		530	2
7/6/2014		530	3
7/7/2014		530	1
7/9/2014		530	3
7/10/2014		530	5
7/11/2014		420	2
7/11/2014		530	10
7/13/2014		450	1
7/14/2014		530	5
7/15/2014		530	35
7/16/2014		450	1
7/16/2014		530	10
7/17/2014		440	1
7/17/2014		530	8
7/18/2014		530	14

Nontarget species will only have data for 3 columns of the exported *Fish table* in Excel: date, species, and number.

After the Chinook salmon data and the nontarget species data are incorporated into the same Excel spreadsheet in the format that matches the *FishDataTbl* in the Ninilchik master database, you're ready to import.

Make a copy of the Ninilchik master database first and then import the data by selecting the data in the Excel spreadsheet and copying and pasting it into the *FishDataTbl* in the Ninilchik master database. Check each field to make sure the data are displayed in the correct format. Go through and proof the data again to make sure everything imported correctly.

-continued-

FishDataTbl

FishNo	Date	Hour	Species	No	AdFin	Fate	Sex	Jack	MEF	Card	Col	Recap	Mark	CW
20602	7/31/2014	2:00:00 PM	410	1	1	6	1	0	0	0	0	0	1	
20610	7/31/2014	2:00:00 PM	410	1	0	6	2	0	850	0	0	0	1	
20611	7/31/2014	2:00:00 PM	410	1	0	6	2	0	670	0	0	0	1	
20612	7/31/2014	2:00:00 PM	410	1	0	6	2	0	760	0	0	0	1	
20613	7/31/2014	2:00:00 PM	410	1	0	6	2	0	870	0	0	0	1	
20587	7/31/2014	9:00:00 AM	410	1	1	5	2	0	0	0	0	0	1	
20615	7/31/2014	2:00:00 PM	410	5	0	5	2	0	0	0	0	0	1	
20607	7/31/2014	2:00:00 PM	410	1	1	6	1	0	0	0	0	0	1	
20617	7/31/2014	7:00:00 PM	410	1	1	2	2	0	0	0	0	0	1	
20618	7/31/2014	8:00:00 PM	410	18	0	1	2	0	0	0	0	0	1	
20619	7/31/2014	8:00:00 PM	410	11	0	1	1	0	0	0	0	0	1	
20620	7/31/2014	9:00:00 PM	410	13	1	8	1	0	0	0	0	0	3	
20621	7/31/2014	10:00:00 PM	410	30	1	8	1	-1	0	0	0	0	3	
20622	7/31/2014	10:00:00 PM	410	2	0	1	1	0	0	0	0	0	1	
20623	7/31/2014	11:00:00 PM	410	22	1	8	1	-1	0	0	0	0	3	
20614	7/31/2014	2:00:00 PM	410	1	0	6	2	0	800	0	0	0	1	
20595	7/31/2014	2:00:00 PM	410	1	1	6	2	0	810	0	0	0	1	
20588	7/31/2014	2:00:00 PM	410	1	1	6	2	0	770	0	0	0	1	
20589	7/31/2014	2:00:00 PM	410	1	0	6	2	0	730	0	0	0	1	
20590	7/31/2014	2:00:00 PM	410	1	0	6	2	0	720	0	0	0	1	
20591	7/31/2014	2:00:00 PM	410	1	0	6	2	0	875	0	0	0	1	
20592	7/31/2014	2:00:00 PM	410	1	0	6	2	0	765	0	0	0	1	
20609	7/31/2014	2:00:00 PM	410	1	1	6	1	0	0	0	0	0	1	
20594	7/31/2014	2:00:00 PM	410	1	0	6	2	0	770	0	0	0	1	
20606	7/31/2014	2:00:00 PM	410	1	0	6	2	0	730	0	0	0	1	
20596	7/31/2014	2:00:00 PM	410	1	0	6	2	0	660	0	0	0	1	
20597	7/31/2014	2:00:00 PM	410	1	1	6	2	0	840	0	0	0	1	
20598	7/31/2014	2:00:00 PM	410	1	0	6	2	0	810	0	0	0	1	
20599	7/31/2014	2:00:00 PM	410	1	0	6	2	0	770	0	0	0	1	
20600	7/31/2014	2:00:00 PM	410	1	0	6	2	0	810	0	0	0	1	
20601	7/31/2014	2:00:00 PM	410	1	1	6	2	0	820	0	0	0	1	
20603	7/31/2014	2:00:00 PM	410	1	0	6	2	0	780	0	0	0	1	
20605	7/31/2014	2:00:00 PM	410	1	1	6	1	0	0	0	0	0	1	
20593	7/31/2014	2:00:00 PM	410	1	1	6	2	0	725	0	0	0	1	
20624	7/31/2014		530	20										

Record: 1 of 11200 No Filter Search

APPENDIX F: NINILCHIK RIVER WEIR REPORTING AND SCHEDULE

Appendix F1.–Ninilchik River daily log, 2018.

Ninilchik River Daily Log, 2018

Day	Date	Crew	video software notes (motion detection adjustments, glitches, etc)	camera box gear (lights, glass clean, camera box water)	notes on weir failures/holding area escapees, etc.	other notes (rising/falling water conditions, etc)
Mon	21-May					
Tue	22-May					
Wed	23-May					
Thu	24-May					
Fri	25-May					
Sat	26-May					
Sun	27-May					
Mon	28-May					
Tue	29-May					
Wed	30-May					
Thu	31-May					

Appendix F2.–Weir crew work schedule.

Day	Date	Activity	Crew
Monday	21 May	weir installation	crew + APU
Tuesday	22 May	video monitoring	vacant weir support tech
Wednesday	23 May	video monitoring	vacant weir support tech
Thursday	24 May	video monitoring	Courtney
Friday	25 May	video monitoring	Courtney
Saturday	26 May	video monitoring	vacant weir support tech
Sunday	27 May	video monitoring	vacant weir support tech
Monday	28 May	video monitoring	vacant weir support tech
Tuesday	29 May	video monitoring	vacant weir support tech
Wednesday	30 May	video monitoring	vacant weir support tech
Thursday	31 May	video monitoring	Courtney
Friday	1 Jun	video monitoring	Courtney
Saturday	2 Jun	video monitoring	vacant weir support tech
Sunday	3 Jun	video monitoring	vacant weir support tech
Monday	4 Jun	video monitoring	vacant weir support tech
Tuesday	5 Jun	video monitoring	vacant weir support tech
Wednesday	6 Jun	video monitoring	vacant weir support tech
Thursday	7 Jun	video monitoring	Courtney
Friday	8 Jun	video monitoring	Courtney
Saturday	9 Jun	video monitoring	vacant DC tech 2
Sunday	10 Jun	video monitoring	vacant DC tech 2
Monday	11 Jun	video monitoring	vacant DC tech 2
Tuesday	12 Jun	video monitoring	vacant DC tech 2 or 1
Wednesday	13 Jun	video monitoring	vacant DC tech 1
Thursday	14 Jun	video monitoring	vacant DC tech 1
Friday	15 Jun	video monitoring	vacant DC tech 1
Saturday	16 Jun	video monitoring	vacant DC tech 2
Sunday	17 Jun	video monitoring	vacant DC tech 2
Monday	18 Jun	video monitoring	vacant DC tech 2
Tuesday	19 Jun	video monitoring	vacant DC tech 2 or 1
Wednesday	20 Jun	video monitoring	vacant DC tech 1
Thursday	21 Jun	video monitoring	vacant DC tech 1
Friday	22 Jun	video monitoring	vacant DC tech 1
Saturday	23 Jun	video monitoring	vacant DC tech 2
Sunday	24 Jun	video monitoring	vacant DC tech 2
Monday	25 Jun	video monitoring	vacant DC tech 2
Tuesday	26 Jun	video monitoring	vacant DC tech 2 or 1
Wednesday	27 Jun	video monitoring	vacant DC tech 1
Thursday	28 Jun	video monitoring	vacant DC tech 1
Friday	29 Jun	video monitoring	vacant DC tech 1
Saturday	30 Jun	video monitoring	vacant DC tech 2
Sunday	1 Jul	video monitoring	vacant DC tech 2

-continued-

Appendix F2.–Page 2 of 2.

Day	Date	Activity	Crew
Monday	2 Jul	install live box	vacant Nin tech 2
Tuesday	3 Jul	weir operation	vacant Nin tech 2 or 1
Wednesday	4 Jul	weir operation	vacant Nin tech 1
Thursday	5 Jul	weir operation	vacant Nin tech 1
Friday	6 Jul	weir operation	vacant Nin tech 1
Saturday	7 Jul	weir operation	vacant Nin tech 2
Sunday	8 Jul	weir operation	vacant Nin tech 2
Monday	9 Jul	weir operation	vacant Nin tech 2
Tuesday	10 Jul	weir operation	vacant Nin tech 2 or 1
Wednesday	11 Jul	weir operation	vacant Nin tech 1
Thursday	12 Jul	weir operation	vacant Nin tech 1
Friday	13 Jul	weir operation	vacant Nin tech 1
Saturday	14 Jul	weir operation	vacant Nin tech 2
Sunday	15 Jul	weir operation	vacant Nin tech 2
Monday	16 Jul	weir operation	vacant Nin tech 2
Tuesday	17 Jul	weir operation	vacant Nin tech 2 or 1
Wednesday	18 Jul	weir operation	vacant Nin tech 1
Thursday	19 Jul	weir operation	vacant Nin tech 1
Friday	20 Jul	weir operation	vacant Nin tech 1
Saturday	21 Jul	weir operation	vacant Nin tech 2
Sunday	22 Jul	weir operation	vacant Nin tech 2
Monday	23 Jul	weir operation	vacant Nin tech 2
Tuesday	24 Jul	weir operation	vacant Nin tech 2 or 1
Wednesday	25 Jul	weir operation	vacant Nin tech 1
Thursday	26 Jul	weir operation	vacant Nin tech 1
Friday	27 Jul	weir operation	vacant Nin tech 1
Saturday	28 Jul	weir operation	vacant Nin tech 2
Sunday	29 Jul	weir operation	vacant Nin tech 2
Monday	30 Jul	weir operation	vacant Nin tech 2
Tuesday	31 Jul	weir operation	vacant Nin tech 2 or 1
Wednesday	1 Aug	weir operation if needed	vacant Nin tech 1
Thursday	2 Aug	weir operation if needed	vacant Nin tech 1
Friday	3 Aug	weir operation if needed	vacant Nin tech 1
Saturday	4 Aug	weir operation if needed	vacant Nin tech 2
Sunday	5 Aug	weir operation if needed	vacant Nin tech 2
Monday	6 Aug	weir operation if needed	vacant Nin tech 2
Tuesday	7 Aug	weir operation if needed	vacant Nin tech 2 or 1
Wednesday	8 Aug	video monitoring if needed	vacant Nin tech 1
Thursday	9 Aug	video monitoring if needed	vacant Nin tech 1
Friday	10 Aug	video monitoring if needed	vacant Nin tech 1
Saturday	11 Aug	video monitoring if needed	vacant Nin tech 2
Sunday	12 Aug	video monitoring if needed	vacant Nin tech 2